ERGONOMY;

OR,

INDUSTRIAL SCIENCE.

BY

SAMUEL GALLOWAY, A. M.,

PROF. MATH. ET NAT. PHIL.

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BENJAMIN R. SCUDDER.

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CHAPTER I.

THE INDUCTION.

In the nineteenth century of the Christian era, civil society is convulsed with pecuniary distress, scientific strife, moral disorder, and social delirium. These fruits of a highly cultivated age, are well calculated to excite a lively and most reasonable curiosity. Convulsions occurring in an age adorned with science, literature, and religion; in a country endowed with industry, enterprise, and wise institutions, must, by every reflecting mind, be regarded as a very singular phenomenon in the philosophy of human affairs. Such remarkable vicissitudes afford a long series of admonitory lessons; and legislative efforts to improve the Divine economy, like the inscriptions of lovers upon trees, only serve to perpetuate the remembrance of human passions and misfortunes.

Nature, to a philosophic observer, seems to harmonize with absolute benevolence, to design physical and social happiness. Everything seems formed for everything, and subsists by mutually giving and receiving benefits. The extremes of creation are brought into the closest vicinity, the seemingly incongruous elements are blended into the mildest harmony.

As a benign consistency still pervades the material world, pecuniary derangements must result from human annoyances. The unconstrained operation of the Divine laws, would, like oil upon waves, restore these tumultuary occurrences into peaceful tranquillity. The Industrial System, if freed from human interruptions, would proceed with as much regularity as the spheres revolving in the firmament.

The ensuing pages are designed to point out the laws of the Industrial System, to unfold a simple, useful, and elegant science. Observation is the only possible mode of ascertaining the Divine legislation; and a strong impression of this preliminary proposition, effectually debars unprofitable speculations, intricate reasonings, and fallacious conclusions.

To define, to classify, to measure, are the three successive steps in philosophy. The true interpreter of nature notices particular facts, groups such as possess perfect similarity, and points out their respective proportions. To free his reasonings from every possible embarrassment, he singles out his particular fact from the other facts which are irrelevant to his particular purpose. Classification, as it "brings in" particular facts under general classes, is called induction, or the inductive philosophy. Mensuration of every kind is nothing more than a comparison of a quantity with its measuring unit. The mathematician purges his elements from every impurity, classes his facts according to an exact resemblance, and compares his quantities with absolute certainty. Philosophy, in its utmost extension, embraces no more than three distinct operations, which, if illustrated by a few

appropriate examples, will enable us to pass over the Industrial System with satisfaction and success.

1. The first step clears the elementary principle from every impurity. Reasoning starts from axioms upon which the human mind rests with implicit confidence. No plurality is conceivable without an elementary unit, no compound is possible without constituent elements, and no general proposition is supposable without particular facts. A number when separated from every other attribute of body, suggests the same thought to every human mind; and a line when considered as "mere length without breadth or thickness," leaves no possibility for error or confusion. The elementary principles of nature, the ultimate existences, are the particular facts, which, in every science, rise up from an unfathomable deep with unadorned simplicity. The loftiest superstructures are built upon the lowliest facts. The primary notion, of which proportions are the mere development, slumbers in the mind of the rudest peasant; and upon notions so seemingly trivial, are built the loftiest monuments in modern science. Upon the simple basis of gravitation, as an elementary fact, Newton erected the magnificent superstructure of modern astronomy.

2. To classify, the second step in philosophy, is nothing more than grouping facts of the same kind under distinctive "sorts or species." As the principles of nature are classible according to some exact resemblance, the observer discriminates, in a great number of particulars, that common circumstance in which they all agree, and extracts it pure and unmixed, from the other superfluous circumstances. As lines

are classible with lines, surfaces with surfaces, cubes with cubes, mathematical inductions cannot be vitiated by any possible obscurity. Actions which bear an exact resemblance in a single particular, are classible; and science, through comprehensive inductions, is continually extending her already extensive domain. A falling apple suggested to Newton the sublime conception, that the planets had the same gravitative generality. An apple and a planet, so dissimilar in other particulars, are precisely similar in gravitation, the only particular which relates to practical astronomy. The science of the philosopher differs in degree only, not in kind, from the information, which is the fruit of the commonest experience. Newton, in classing the planets under gravitation, only enlarged his views to that universal induction which comprehends under it an infinite number of particulars, and includes a whole science in a single principle.

3. To ascertain proportions, is the third step in philosophy. Newton discovered the proportion of the forces of gravitation acting at comparative distances; and the rule of action, the inverse squares, is established by observing the planetary motions. Gravitation, acting by this determinate rule, moves an apple and a planet, moulds the huge masses of bodies into their appointed forms, and governs, through myriads of ages, the mighty system composed of myriads of worlds. This comprehensive rule, throughout the minutest details, so explains the celestial appearances that every seeming irregularity becomes a necessary result. Composed of system within system, the phy-

sical universe, "ordered by number and measure," moves with beautiful and salutary regularity.

Measuring, after a unit of comparison is selected, is reduced to counting. To measure a quantity is nothing more than comparing it with some other quantity of the same kind, a quantity exhibited to the human senses. A measure of length must be length; a measure of superficies must be superficies; a measure of capacity must be capacity. "To measure a quantity," is to "fix upon some known quantity of the same species" for a measuring unit, and to determine the proportionality of the quantity to the measure. Time, a definite portion of duration, is measurable by "any instruments or marks which divide it into equal portions;" and the geometer selects "some measure of this common duration" to estimate planetary motions, to ascertain longitude at sea. "Without some fixed parts or periods, the order of things would be lost to our finite understandings, in the boundless invariable oceans of duration and expansion which comprehend all finite being, and in their full extent, belong only to the Deity." Quantities of every kind are expressible by numbers; the number always expresses "how many times the assumed unit of quantity is contained in the given quantity."

The inductive method, as illustrated in the preceding examples, leads us along the only true road to science. A method so successfully used in modern investigations, is applicable, with equal success, to Industrial affairs. The philosopher, in this Science, defines his axiom, classes the elementary facts under a universal induction, and determines the numerary

proportions. To collect particular facts, to assort them into appropriate groups, to weave the whole into a connected system, is the task devolving upon philosophic economists. This extensive field, abounding with scientific curiosities and moral felicities, presents attractions to inductive philosophers and observant historians. This extensive range, as in other sciences, exemplifies the three elementary operations in philosophy.

1. Human labor is the sole elementary axiom. Labor, being irresolvable into simpler elements, is a clear and comprehensive elementary principle. A commodity, a specific body, is nothing more than labor, the only contemplated attribute, embodied in a perceptible form. The astronomer solely considers gravity; the economist solely considers labor. In computing pressures, an engineer leaves out of view the freshness and salubrity of fluids; in calculating eclipses, an astronomer does not include the fertility and population of planets; and in estimating elaborations, an economist excludes from consideration the form and beauty of commodities. The notice of excluded attributes, though real existences, would only confuse the human mind. The exclusion of extraneous considerations leaves the elementary axiom in absolute purity, and enables the student to glide along a limpid stream.

This elementary axiom possesses interesting peculiarities which augment its perspicuity and impressiveness. Existing materials have no exchangeable proportions, till men have acquisitions to compare, acquisitions which require human labor. The first occupant

of any material, being unable to purchase of the Supreme Proprietor, expends labor upon a Divine gratuity. As no exchangeability can come into play before acquisitions are compared, the Industrial attribute is distinctly designated from every original attribute which inheres in material substances. Exchangeability decreases towards the first elaboration where, without leaving any residual quantity, it entirely disappears. The labor embodied in a commodity is accumulative till that commodity comes to the mart for consumption. Cotton, the result of the planter's labor, receives an accession of labor by its transportation to the English manufactory, by its transmutation into cloth, by its re-transportation to America. A similar accession occurs in elaborating every particular commodity. As the Industrial attribute is generated by man, he has the acutest experience of its actual existence. Ten thousand daily sensations make an indelible impression of the labor expended in elaborating commodities. Continuous elaboration is necessary for the prolongation of man's physical existence, for the development of his corporeal powers, mental faculties, and moral sensibilities.

2. Industrial facts from their absolute purity, are classible by mathematical resemblances. Equivalent commodities exhibit a wide diversity in weight, length, superficies, capacity, form, color, and fragrancy ; while, on the contrary, inherent labor is the sole attribute of coincidence, the only discriminating attribute in the "Industrial Science." The similarity of the elements, being impressed in human experience, are clearly discernible ; and the reasonings, being mathematical

comparisons, are conductable with as much certainty as those in hydraulics or astronomy. A precise resemblance in labor suggests a comprehensive induction in commodities. The astronomical induction was a happy suggestion of an occult attribute of matter; while, on the contrary, the induction of commodities is suggested by daily sensations and reflections in conferring the peculiar attribute. While minor distinctions are blended into each other's shades in inseparable complexity, the Deity is pleased to exhibit comprehensive inductions for human use, to hide minor differences from impertinent curiosity. The universal induction of labor, a useful extension of thought, includes a whole science in a single principle.

3. The third step is to measure human labor. Man, in the act of elaborating, obtains an acute perception of Industrial proportions, and, with the greatest facility measures a quantity which has been conferred by his own exertions. Labor, like a line in geometry, is an inseparable attribute of body, and, like a longitudinal quantity, is only calculable by the body in which it inheres. As gravity is inseparable from planetary bodies, so labor is inseparable from the containing substances. Mensuration in astronomy depends on a measure of force; so mensuration of commodities depends on a measure of labor. A portion of matter is assumed as a measure of gravitation; so a portion of elaborated matter is assumed as an Industrial measure. The Industrial unit "constitutes the standard or scale by which the prices of all things bought or sold are ascertained." A portion of silver being assumed as a unit, the number of times that portion is exchangeable

for any given commodity, is the measure of that given commodity.

After a unit is fixed, commodities are exchanged solely by arithmetic. Children distinguish simple proportions, and the proportionality of commodities is fixed on the human mind with absolute clearness. The proportionality of gravitation at comparative distances, a proportionality of secondary utility, is within the range only of highly cultivated minds; while, on the contrary, the proportionality of labor, a proportionality applicable to life and morals, is perfectly familiar to a child in the nursery. As the proportionality of labor is so important in human affairs, no intricate proportions were admitted into the Industrial economy. These problems do not require a solution by the complicated proportions of squares or cubes, by the abstruse properties of ellipses or parabolas. As few minds are adequate for recondite mensuration, the Deity has been pleased, in the Industrial System, to work solely by simple multiples. From its beautiful simplicity, the proportionality is comprehensible by the feeblest as well as by the most cultivated understanding.

Industrial facts being delivered with mathematical solemnity, require a mathematical language. Every science has its peculiar nomenclature for its leading principles; and technical terms, being selected from the dead languages, are not liable to change by popular usage. As these terms are used in a precise sense, the mind preserves a pure conception of their distinctive meanings. Ergonomy is derived from two Greek

words, and means the law of labor. It is a term which is unincumbered with an impure usage.

Industrial Science requires only a single axiom, only one specific induction, and only one simple proportionality. It has a most impressive axiom, a most luminous induction, and a most elegant simplicity. From a single axiom arises a choice collection of interesting developments; and these shifting scenes afford the most striking facts in human history, facts which excite lively emotions in every inquisitive mind. The variety of facts possessing a strict unity, prevents the repetition of a uniform narrative; and by employing general propositions, the human mind comprehends in a few theorems, a great number of inferences and conclusions. As the science of labor is a vast collection of facts, the economist only retains the more striking results, and drops all minuter circumstances which are only interesting to particular pursuits. In these comprehensive inductions, the natural connection is unbroken by hasty transitions, and no minute accumulation of circumstances can destroy "the light and effect of those general pictures, which compose the use and ornament" of the Industrial economy. To restrain the wanderings of the fancy, the economist must look to the Industrial axiom, with as much singleness of purpose as the faithful Mohammedan at Fez or Delhi turns his face towards the temple at Mecca.

A beautiful simplicity runs through the sciences which affect human life and social manners. To effect a variety of purposes by a single principle, is characteristic of Deity. The law of labor, like that of gravitation in astronomy, explains all the Industrial appear-

ances in their minutest details, and inspires the coldest natures with reverential sentiments. The several departments, being conductible by the inductive mode, are investigated by the same philosophic principles. The physical world, which still maintains its original affinities and proportions, affords a permanent basis for the moral sciences. The investigation of the physical laws, paves the way for the moral departments, which complete the harmonious superstructure.

To enrich the subject, to relieve the severity of thought, to entertain the reader, the leading principles are interspersed with variegated examples. As these examples are introduced merely as illustrations, particular reference to their original sources, is deemed unnecessary. The author, once for all, acknowledges his indebtedness to a wide circle of ancient and modern literature. The volume, as it treats of a science applicable to every nation, is designed for popular reading as well as for recondite study. The work, the first of a series, is committed to a generous, indulgent, and enlightened community.

CHAPTER II.

THE LABORATORY.

MATERIAL substances are the substratum for human labor. The materials are formed into curious structures, arranged into symmetrical figures, or cast into heaps of rude magnificence. The earth, the grand laboratory, contains the materials of the several kingdoms of nature, a mixture of the dullest with the most resplendent substances. Nature, in her active laboratory, is continually working up the rude materials, and her frugal economy makes one set of materials perform many purposes. Specific materials are running through the several kingdoms of nature with more or less rapidity, and blending into each other by almost evanescent shades. Nature mounts up in the gentlest ascent from dead matter to the delicate structure of the human brain, and fills up the widest extremes by the nicest gradations. The sportive variety in details, is a serious uniformity in leading principles. Nature, which performs for man the humblest services, is moving with ceaseless activity over wider scenes in mightier operations.

The earth, being the storehouse of appropriate materials, effective agencies, and elegant models, requires a description so minute as to point out its elaborative

capabilities. This description will furnish instructive analogies, and impart perspicuity to subsequent reasonings. The materials, with the various laws employed in elaboration, are splendid gratuities for which the Deity does not receive the least equivalency. This universal induction, kept always in sight, will give us luminous conceptions, extensive views, and infallible conclusions.

More than fifty distinct elements, in various combinations, compose the material world. Silica, composing rocks and sands, appears in amorphous or crystalline magnificence; and alumina, next in abundance, usually appears in rude masses, but is nearly the sole constituent of the ruby and the sapphire, two of the most beautiful gems. Lime, magnesia, and oxide of iron, are abundant materials; while glucina is found only in the euclase, the beryl, and the emerald. The organic elements are dissipated by burning in the atmosphere.

Primitive rocks compose the frame of the globe, form the loftiest mountains, and extend below the other formations. Transition rocks, composed of primitive fragments consolidated into continuous masses, often contain much organic remains, with various metallic ores. Secondary formations, showing a less crystalline structure, contain organic remains of known existing species. Alluvial deposits are those accumulations which are constantly forming by fluvial currents and mountain torrents.

The various strata on the large scale, are wrapped round the globe like the layers of an onion, maintaining the same relative situation. They have an incli-

nation to the horizontal plane, an arrangement which successively exposes a rich variety of minerals at the surface. Gneiss forms the vast mass of the Carpathian mountains; and granite, which frequently rises to the surface, composes the tops of the loftiest mountains, as well as the basis of the earth's solid crust. Granitic rocks not adapted to afford a fertile soil, generally constitute mountain districts which are ill-suited for human habitations; while, on the contrary, level and temperate regions are usually composed of strata containing those ingredients which are subservient to luxuriant vegetation.

Each element from the Divine mensuration, enters into combination by numerary proportions. Particles possess elective affinities which, under given circumstances, seize upon other particles within their attractive sphere. Hydrogen unites with eight times its weight of oxygen; and each element combines by its simple equivalent, or by some of its multiples. The Deity has measured the waters, meted out the heavens, weighed the mountains, and established batteries to separate compounds, to combine substances into new arrangements, to modify chemical forces in endless complexity.

Hydrogen, a highly inflammable, united with oxygen, a strong supporter of combustion, produces water, which can neither be set on fire nor support flame. The one loses its supporting power; the other lays aside its combustibility. Muriate of ammonia is a solid substance formed by a liquid with a gas; and carbonate of ammonia, a hard crystallization, results from the union of two invisible gases. Iodine, the vapor of

which is of a violet hue, forms a red compound with mercury, a yellow one with lead. The difference between white and red lead, arises solely from the amount of oxygen in their respective compositions. A brown oxide of copper gives rise to a blue salt; while a salt of a yellow oxide of lead, is colorless. A substance, in successive combinations, is blue in the pink, white in the rose, purple in the hyacinth, poisonous in the upas, delicious in the melon, and medicinal in the aloe. Tungsten, compounded with chlorine, appears as a deep red mass with a brilliant fracture, or in the form of delicate needles of a deep red color, resembling wool.

Bodies which evince little disposition to combine, decompose from the slightest causes; and those which contain the highest quantity of gas, easily part with one equivalent. As combustion is nothing more than rapid oxidation, every combustible derives its power of burning in the open air, from its affinity for oxygen. A disengagement of gas produces effervescence; and carbonate of soda separates itself by efflorescence, from a mixture of carbonate of lime and sea salt in the soil. Carburetted hydrogen collects in mines, mingles with the atmosphere, and forms explosive mixtures. When cohesion becomes too strong for affinity, particles arrange themselves into symmetrical forms, which are reducible to a common axis.

Caloric, which converts solids into liquids and liquids into gases, removes barriers to affinity. Sometimes a higher, sometimes a lower temperature, accompanies chemical action. Caloric keeps up vital action; the electric fire, which purifies the stagnant atmosphere above, fuses the mineral veins beneath; and the ver-

nal sun causes the seed to burst its envelope, the new plant to expand with leaves, and the fruit to arrive at maturity. It warms the blood, melts metals, expands the air, raises clouds, and clothes the earth with verdure. From the proportionate activity of attractive and repulsive forces, result solidity, fluidity, elasticity, viscidity, toughness, and symmetry.

1. At the hot springs of San Vignone, a coat of lime-stone is formed six inches deep, in a year. Drifting winds have inundated the coast of Cornwall with sand, which, with oxide of iron in aqueous solution, has formed stone fit for architectural purposes. The herbage along a stream in one of the Azores, is encrusted with silica in all the successive steps of petrifactions from a soft state to a complete conversion into stone. In some locations, fine particles of lime or quartz, crystallize into marble, alabaster, cornelians, stalactites, or rock crystals.

The soil holds in solution those substances which pass into vegetable structures. Silica imparts friability to soils; alumina, a plastic character; and lime a medium texture. After decay has effaced every trace of organization, the remains contribute to vegetable developments. Silica, which is made available to plants through the intervention of soda or potassa, is necessary to sustain a stem in an upright position. Alumina, which furnishes little aliment to plants, has indirect influences proportionate to its conspicuous position in soils.

The proportion of oxygen and nitrogen in the atmosphere, is nearly the same in all elevations and latitudes. Oxygen is necessary to fermentation, to

combustion, to the germination, development and maturity of plants. Nitrogen neutralizes oxygen for respiration and combustion; and carbonic acid, the proper food of plants, forms sometimes the five hundredth part of the volume of the atmosphere. Water, which exists as an elastic fluid in the atmosphere, is, by a diminution of temperature, condensed into clouds.

2. Vegetable life transforms dead matter into organized bodies. The tenderest organs and the mildest solutions, produce combinations which the chemist cannot form with the most effective apparatus and the strongest acids. Nitrogen derived from putrifaction, is united to other elements for forming nutritive substances; and many compounds become necessary mediums in effecting final developments, in stimulating plants to appropriate elementary particles. Vegetation transforms brown earth, insipid water, and invisible gas into elegant flowers, delicious fruits, and sturdy trees.

The seed-lobes nourish the young plant till its organization can draw materials from extraneous sources. Roots, so unpleasing to the sight, fix the plant in the ground, draw moisture by appropriate vessels, and turn in pursuit of appropriate nourishment beneath the surface. Trees which grow on mountains, fasten their long branching roots into the clefts of rocks, for braving storms and tempests. A tree which stands on a wall, as soon as unsteadiness occurs, stops its upward growth, to send down a root to the ground for establishing a firm position. Trees, according to their wants, direct their roots towards dry or moist earth; and plants of the same species put forth fibrous or

bulbous roots, to suit the soil on which they stand. One plant appropriates potassa, and another, standing in the same vicinity, assimilates silica in large proportions.

Plants springing up where the seeds are cast, grow up with a sufficient covering to protect their delicate internal structure. The grasses, which robe the earth with universal verdure, possess such unconquerable vitality as to survive wasting desolations and severe pressures. The stem of corn, without bark or woody fibre, has a silicious exterior to protect its interior, "like a casing of metal" "corroborated by sheaths and knots." An imperial infant reposing in its cradle enriched with cunning devices, is less brilliantly lodged than the ripening seed which is nursed in "the lily's bell, or the violet's cup." The concave petals are gracefully curved around the centre, to reflect warmth, and to guard against injury. "As the mother folds her nursling to her bosom," so the instinctive blossom folds her own frail loveliness around her still more fragile offspring.

To the bark succeeds a green substance, then a reservoir of moisture or vital energy. The pores admit light and heat, which modify colors, tastes, and fragrancies. The sap vessels are coated and spiral, and the food which is furnished by the soil or the air, is taken by introception in liquid or gaseous forms. Nutriment is conveyed from the lowest fibres to the highest twigs; and vessels corresponding to the lacteals of animals, are distributed in minute ramification over the surface of the leaves. The fluids, after undergoing chemical transformations, deposit, in the

various parts, their respective secretions. Leaves undergo the most elegant metamorphoses; and buds "come forth closely packed and enveloped with imbricated coverings." Buds shoot into branches, expand into leaves, effloresce into blossoms, contract into pistils, and swell into fruit "through all the varieties of nuts, pods, and berries."

Concentric circles, as in the dogwood, beautifully diversify the woody fibres. The apple, so delicately fragrant, is often of so deep a red that the boughs seem hung with rubies, or touched with fire just kindling into flame. To the oak is imparted a tanning principle; to the cinnamon, a grateful taste; to the cinchona, a febrifuge quality. The Indian cassava, which has edible leaves, secretes a poisonous oil in its roots; and the cinnamon, which has bark so exquisitly fragrant, puts forth a flower which is highly offensive. The accacia contains a sweet gum in its bark, an offensive fluid in its root, an astringent juice in its stem, and a regaling odor in its flower. The rose pours fragrancy from its coral; the juniper, from its trunk; and the heliotrope, from its leaves. Elegant florets scent new-made hay; sandal wood sheds its sweet perfume upon the felling axe; and minute plants afford a delicate fragrancy at eventide.

Plants embellish the barren scenery with flowers, which hang down from the drooping branches like tassels, exhibiting the richest purple with the deepest crimson. The dogwood, a lovely ornament of the wild, luxuriates in swamps, or shoots from the clefts of precipitous ledges. The magnificent tulip-tree lifts its towering head, and displays its brilliant goblets. The

water lily "has been called the queen of flowers, the swan of the waters, the lady of the lake, the river nymph, the white rose of the rivulet." "It is so graceful, so fragrant, so magnificent," "that this profusion of praise falls below its exquisite loveliness."

In the forests of Brazil, parasites climb the loftiest trees, descend to the ground, re-ascend from roots, spread in every direction, tangle themselves in every possible form, and festoon the woods with variegated flowers and rich verdure. These vegetable boas, after strangling their victims, remain attached to the surrounding trees, and form magnificent twisted columns, around which a fresh growth of plants soon rises, twisting and clinging with an indescribable grace. Nature banishes everything ugly, melancholy or repulsive; everything which speaks of gloom, decrepitude, or decay. Amidst the breath of eternal spring, fruits and flowers, in colors ever fresh, load the same branches in constant succession. As soon as a tree shows symptoms of decay, thousands of climbing plants weave a covering robe, descend from the summit, playfully wave their plumes, sportively embrace other climbing parasites, and finally lose themselves in the immense thicket. No sooner does a tree fall, than parasites begin to prepare its funeral pall, its gorgeous canopy, and its sofa velveted with delicate plants. The shroud of death is so embellished as to appear the graceful drapery of a festal scene.

Plants form aliments for animals, which are chiefly nourished with organic substances. As only a small part of seeds and fruits are needed for germination, the redundancy affords relief to the necessities of ani-

mated nature. "There is more sweetness in the orange, more oil in the olive, more juice in the peach, more pulp in the apple than the nourishment of the embryo requires."

3. Animal chemistry produces living tissues; and life, the active state of an animal, includes sensation with the ordinary attributes of living beings. Sensation belongs exclusively to living organic structures; and life necessarily pre-supposes an organic structure for a visible residence. The body is an apparatus contractable by volition, an organization which enables the animal to provide for its own safety. It neither grows perpendicular to horizontal planes, nor preserves a parallel direction in the vessels containing its fluids, and, though subject to gravitation, overcomes some of its ordinary influences. As long as vitality remains, the organism does not yield to the ordinary elective affinities.

Iron is found in the blood, lime in the bones, and silica in the enamel of the teeth. Soda, phosphorus, and sulphur, are assimilated into the body; and acids, variously combined, are found in the solid as well as in the fluid parts. Gelatin and albumen constitute the transparent membranes; fibrin, the muscles and ligaments. Bones, the basis of the frame, are connected by ligaments, and covered with fibrous membranes. Muscles move the solid parts, fat lubricates the articulations, and cellular substances furnish a soft bed for the vessels and nerves. Mucous membranes coat the canals, while serous membranes line the cavities, soften the surface, and give the internal organs an

easy motion. Glands secrete the various fluids, and vessels circulate them among the organs.

A million of living beings are sometimes no larger than a grain of sand. Ten millions of millions occupy only a cubic inch, and beds of silicious earth are made up of remains secreted by a species little larger than these. The smallest infusoria possess five or six stomachs, and a mouth surrounded with many hair-like appendages. Some infusoria possess a secreted shell of pure and transparent silica, sculptured with a beautiful complicated pattern so well defined as to distinguish the species. Some animals are soft as wool, others are hard as stone; some rise like a leafless shrub, others expand like a net. Some hang their heads downwards, others spring from the jutting rock, and, like the plantations of Semiramis, may properly be called pensile gardens.

The shells of animals, so seemingly irregular, have dispositions nicely suited to their peculiar exigencies. Neither the Ionic delicacy, nor the Corinthian richness of architecture, could so well subserve their purposes as their present homely fortifications. Some, however, have a symmetrical figure, and a most elegant polish. Some are "rolled up cylindrically," some have almost an endless variety of surfaces apparently covered with scales, and some are exquisitely beautiful both in form and coloring. Nothing can exceed the delicacy with which some are marked, or the rich tints with which others are stained. The fish which dwells in the mother of pearl, is a lovely mixture of red, blue, and green, delightfully staining the clearest ground. In the scales of fishes, in the shells of beetles, in the wings of but-

terflies, nature sports with her pigments in the happiest caprices.

The infusoria, from their incredible number, their universal distribution, and their insatiable voracity, devour particles of decaying matter, and prevent the diminution of organized substances upon the earth. The salubrity of the atmosphere is secured by these "active invisible scavengers," which, as "wakeful members of nature's invisible police, are everywhere ready to arrest the fugitive organized particles, and to turn them back into the ascending stream of animal life." As soon as they convert the decomposing particles into their own living tissues, they become food for larger infusoria, which, in turn, are devoured by larger animals. A pabulum is formed "fit for the nourishment of the highest organized beings," a pabulum "brought back by a short route from the extremity of the realms of organized matter."

The coral reef of Australia, a thousand miles in length, was constructed by animals varying from a pin's head to a pea in magnitude. The pleasures of animated existence is conferred upon such myriads of instinctive beings buried in the ocean. Not being able to work above water, they raise their structures perpendicularly to the windward to break the waves and continue their labors to the leeward. They form basins from which the sea-water is gradually excluded, and into which fresh water falls from the clouds, to supply the perishing mariner who is wrecked upon these bold shores. The red coral so much esteemed as ornaments, are so minute as to be detected with difficulty.

Wasps divide their dead companion to get it out of

the hive; and caterpillars shaken from a tree, though they have never been on the ground before, instantly turn towards the trunk to ascend. Beavers cut down logs, construct dams across streams, and erect commodious habitations. Termites, with a division into nobles, soldiers, and laborers, build large pyramidal structures consisting of arched chambers, stairways, passages, bridges, and nurseries. Bees, without studying astronomy, observe the return of the seasons, without going through a course of botany, select the plants best suited to their purposes, without serving an apprenticeship in the laboratory, become complete practitioners in combination and analysis. The nautilus, which ejects water to raise himself to the surface, floats by throwing out two feelers to serve as oars. In a favorable breeze, he spreads a fine membraneous sail on two extended limbs, and displays his nautical skill by numerous evolutions. In case of danger, he draws in water, hauls in, coils up his tackle, and sinks to the bottom.

The domesticated ox performs a conspicuous figure in early history. He is among the signs of the zodiac, and typifies the sun in several mythologic systems. He was adored in Egypt, and is still venerated in India. The cow is a mystical type of the earth in the systems of ancient Greece; and in the Vedas of India, she is considered the primordial animal, the first created by that deity who was directed to furnish the earth with animated beings. The body, in one race, is bedecked with the richest hues of red and white, so arranged as to form a delicate roan. Small limbs, a deep neck, wide nostrils, veiny ears, pointed horns, and

"mildly beaming eyes," exhibit a symmetry and beauty irresistibly attractive.

II. Gravitation, which acts between the minutest particles, transmits its influence to all bodies. The rotary motion of the earth which causes an elevation at the equator, forms the level which retains the waters in their present channels. The absolute quantity of water is suited to equilibrate with the land, and its specific gravity keeps the ocean within its appropriate limits. The relative quantities of sea and land are so adjusted as to supply the earth with moisture, without seriously diminishing the ocean. Tides, which are caused by solar and lunar attraction, rise from five to forty feet. The height of the tide at any given place, depends much on the shape of the land against which the great tide wave strikes.

The expansion of the atmosphere by caloric, sets the elastic fluid in motion. The rarefied air and the diurnal motion of the earth, cause the trade winds within the tropics. In the Indian ocean, the trade winds are curiously modified by surrounding lands. Under the lee of the African shore, near the Cape Verde islands, calms and variable winds prevail; and the lofty barrier of the Andes, shelters the ocean for nearly eighty leagues. The shores within the tropics are refreshed by alternate breezes.

The trade winds produce a current across the Pacific, Indian, and Atlantic oceans, modified by lands and currents from the Polar seas. A current runs from the Cape of Good Hope, by the Cape Verde islands, through the Caribbean sea, round the Gulf of Mexico, through the Straits of Florida, along the shores of

Newfoundland, by the Azores and Canaries into itself. One branch of this current runs into the Mediterranean sea; another along the shores of Brazil, through the Straits of Magellan into the Pacific Ocean. The endeavors of the ocean to equalize its temperature, modify the temperature of its vicinity. The water which is heated within the tropics, is carried by currents to the borders of the frigid zones. The particles of water, during crystallization, so arrange themselves as to lessen specific gravity. The ocean, for five hundred miles around the poles, is constantly covered with ice which is often floated far within the temperate zones. The vapor arising from the ocean, forms clouds which fly to distant regions, giving out heat and water. The snow which constantly covers the summits of mountains, tempers the climate below, and serves as a reservoir to send, during summer, refreshing streams to irrigate the plains and valleys.

Existing substances are transported to distant localities, for entering into new combinations and arrangements. The atmosphere separates the waters of the sea from their native saltness, and transmits fresh showers to sustain vegetation and animated nature. Springs and rivers receive occasional supplies from the rains, and perpetually dispense them through curiously constructed valleys into the ocean. Some seeds are fastened to light substances for passing through the air; some are inclosed in a stringy case, the explosion of which spreads them on every side. Some seeds are fastened by hooks to animals for transportation; some are glued to water-fowls for obtaining a passage to distant regions. The Caribbean sea-weed

is wafted by the gulf stream, to feed hungry whales which congregate along the Western Islands.

Nature provides a soil for coral and volcanic formations. Mosses cover the surface before other plants can subsist, and their remains furnish a mould for subsisting plants, the seeds of which are floating on the wind, or swimming on the deep, still retaining their vegetative vitality. These seeds, taking root in the crevices, produce plants, the remains of which, with decomposed coral, form, in a few years, a soil fit for trees and shrubs. Birds sow various seeds, and the swellings of the sea deposit sand, sea-weed, and cocoa-nut shells. The surface is covered with herbage, shaded with forest trees, and rendered habitable by man with his domestic animals.

Mechanic forces are adapted to chemical operations. The force which sends the fluid of plants to the highest leaves, is accurately proportioned to the gravitation of the globe. The upward pressure, which corresponds with the seasons, so proceeds as not to accelerate the rising of the sap, overload the leaves, or interfere with any vital operation. The force of the imbibition of the roots, of the propulsion of the sap vessels, of the operation of the minutest organs, is adapted to the gravitation of the earth. The stiffness of the stalk is so proportioned to the seasons, as to perpetuate the species of those flowers which hang the "pensive head" under the hedges. The vegetative functions are adjusted to the forces determining the position of the branches, the pressure of the atmosphere, and the gravitation of the planet. "The mass of the earth is

employed in keeping a snow-drop in the position, which is best suited to promote its vegetable health."

Gravitation and the animal constitution have a very delicate and indispensable correspondency. The continuous motion of the fluids, so necessary to animal life, is secured by appropriate forces. The beating of the heart urges the blood to the extremities, against gravitation and other resistances. The solids are moved by the tension of muscles produced by voluntary action; and the motions are secured by such a nice adjustment of the organic system to gravitation as to allow lightness to the fawn, speed to the hare, and spring to the antelope. The pressure of the atmosphere is suited to respiration, and to compress the animal frame.

III. The pressure of opposite forces with a determinate limit of disturbance, sheds light on those operations of nature which formerly seemed obscure or anomalous. A beautiful circle of action, a simple comprehensiveness of scheme, a perpetual series of restoration, preserve the indispensable balance of nature in equipoise. Variety and stability result from antagonist forces, from the struggle of which changes occur, and actions tend towards a medium condition. Stability is secured by a complex machinery, which preserves permanency by perpetual change and movement, succession and alternation, seeming irregularity and apparent accident. The excursions are sometimes rapidly restored, sometimes slowly recovered from inconsiderable deviations. Steadiness with perpetual motion, is established by an invariable average of variable quantities so adjusted as not to disturb the gen-

eral constancy. All motions, by a definite rule, vibrate around an indestructible medium, and exhibit, by their proper direction and beneficial application, a most impressive signature of Deity.

1. The stability of the chemical system depends on the equipoise of antagonist forces. Disunion and composition alternately unform and regenerate all nature; and the elements, never worn by usage, perform innumerable cycles. The chemical world, contemplated in its aggregate mass, or in its organized form, exhibits perpetual change with elementary incorruptibility. The organic substances which moulder into an elementary mass, furnish fresh fuel for succeeding generations. Every vestige of their late character is lost, and the materials are appropriated to other purposes. Granitic mountains possess a hardy texture, while the organic world manifests the rapidest changes. The Hindoo mythology represents the Supreme Being as regulating the universe by a triad of inferior deities, a generating, a decomposing, a preserving agency.

The purest metals turn into oxides, the firmest rocks crumble into granules. Oxygen, which is absorbed by almost all mineral masses exposed to the atmosphere, destroys the arrangements of the elements which constitute the hardest aggregate rocks on the globe. Water dissolves gypsum, the atmosphere effloresces limestone, and shell-fish perforate the hardest marbles. The expansion of freezing water rends hard rocks, and comminutes porous substances. Rocks are comminuted in their descent from the mountains, by the lashings of the ocean, and by friction in passing down rapid currents.

The ultimate decay of wood, a slow combustion, forms new bodies; vegetables, by fermentation, undergo alterations in their elementary constitution; and putrefaction transposes the atoms of complex substances into various new arrangements. Cyanogen placed in water, brings into action elective affinities which do not cease till the elements are formed into eight distinctive substances. Plants segregate carbonic acid from the atmosphere, and return purified oxygen for animal use. This beautiful circle keeps up the gaseous proportion, which is suitable for supporting animal as well as vegetable life.

2. The universality of gravitation secures alternation with stability in the whole solar system. Its motions have their cycles, its perturbations, their limits and periods. Its orbits, in the long run, remain unchanged, and the changes occurring in shorter periods, never transgress very moderate limits. Each orbit deviates on both sides of its medium condition, and so recovers from its moderate deviations as to preserve an invariable average. The planets, in their perpetual perturbations of each other's motions, reach a maximum from which they instantly recoil. The progression, in many cases, has proceeded in the same direction ever since the first beginnings of planetary history; and the final restoration, as complete as the seeming derangement, requires, in some instances, millions of years for a periodic accomplishment. The universal law of gravitation, in every case, brings back the planets from their long and almost imperceptible wanderings.

The solid substances annually discharged by the

Ganges, are computed to be three hundred and sixty million tons, sixty times the weight of the great pyramid of Egypt. Rivers rushing from the mountains, carry down innumerable stones, and spread disintegrated masses into the plain. A mountain near Servos lost fifteen million cubic feet, a quantity sufficient to form a large hill. Large masses slide from mountains, and avalanches of sand rush to the plains. Vast masses of rocks separated by frost, fall from the mountains which are subject to the vicissitudes of heat and cold. The massive mountains, seemingly formed for everlasting duration, exhibit ruined cliffs. On the eastern coast of England, portions of cliffs, more than two hundred feet in height, have been precipitated into the ocean by the undermining waves.

Islands are perpetually rising from the ocean, sometimes imperceptibly reared by the diminutive coral, sometimes suddenly thrown up by volcanic agency. In the Southern ocean, coral formations are rising to the surface, overtopping the waters, and forming habitable islands. The Polynesian islands, with few exceptions, are either wholly formed of coral, or girt about with coral reefs. Two new islands have been added to the Aleutian group, and eighteen have been elevated from the sea in the vicinity of the Azores. A new island was recently thrown up among the Ionian group; and the same phenomenon frequently occurs along the Icelandic coast. The volcano, completing the structure of the coral, elevates the mountain for a hydraulic engine, to collect the clouds which fall to fertilize the earth. One of the Tongas, which is formed entirely of coral, rises three hundred feet above the sea, and

another contains a volcano always on fire. The Sandwich, Society, and Marquesas groups, islands of volcanic origin, contain wild and lofty mountains.

The lava thrown out by a volcano in the Isle of Bourbon, in one year, was estimated at sixty million cubic feet. During one eruption in Iceland, the lava flowed over one thousand eight hundred square miles, and several hundred feet deep in some places. The coast of Chili, for the distance of one hundred miles, was elevated several feet by subterranean convulsions. Jorullo has emitted flames ever since it was elevated from the plain on which it stands. Monte Nuovo, in Italy, was elevated four hundred and twenty feet in thirty-six hours. Since the twelfth century, scarcely more than forty years have intervened without eruptions in Iceland. Single eruptions from Hecla, have continued during six years, rending the mountains asunder, and turning the rivers from their channels.

The awful exhibitions which perpetuate the inequalities of the earth's surface, are almost entirely confined to particular regions. The volcanic chain of the Andes, extending from the south of Chili to the north of Mexico, is so uninterrupted that scarcely a degree passes which is not seen "bristling with volcanic cones." A continuous range of nearly equal extent begins at the Aleutian islands, and passes the Moluccas by a circuitous route. A third volcanic range extends from the Caspian to the Azores. Etna and Vesuvius indicate the volcanic disposition of Sicily and Italy. Of the three hundred volcanoes which are active, or liable to sudden eruptions, nearly all are placed on tops of mountains remote from habitable situations.

The vapor which rises from the ocean, falls to the earth, converges into rivers, and returns to its ocean reservoir. The vibrations of the storm become so large that all traces of an original condition seem to be gone, and disorder, like the spread of a conflagration in a city, apparently prevails; but soon new forces come into action, motions take an opposite direction, and the tremendous struggle ends in serenity and peace. As the colder portions of water are descending while the warmer portions are ascending, their mixture reduces the whole mass to a medium temperature. Elements are intermixed in endless complexity, modifying each other's effects in every salutary variety.

CHAPTER III.

THE ELABORATOR.

MAN, consisting of body and mind, is suited for working up the Divine gratuities. The Deity, after furnishing choice materials, variegated laws, and elegant models, gave man intelligence to prepare substances for use. Mind operates only through matter; and mental affections are transferable to perceptible substances. Impalpable thoughts are clothed in words, converted into substantial forms, and rendered perceptible to sense. The artist, as well as the philosopher, is dependent upon body and mind. Both labor with the hand, while the mind directs the manual operations. In every variety of elaboration, no mental or corporeal faculty exclusively works. The commodity, the result of labor, is, in every case, presented to sense. The body and mind constitute the human being, who is one and indivisible, a perceptible individuality.

Man's chemical constitution, mechanical configuration, sensorial apparatus, and intellectual faculties, are suitable to each other as well as to external nature. His several faculties are developed in such nice succession as to secure a successive and salutary activity. Nature is so suited to mind, that mind looks upon nature with pleasure. The lustre which plays around

the universe, secures such an attentive fidelity that the child, without classing its sensations, is charmed with softness, fragrancy, taste, sound, and coloring. The mind forms the heterogeneous mass of past experience unto useful combinations and brilliant fancies. A brief description of the intellectual laborer, may serve to blend scientific instruction with literary amusement.

I. Man, for laboring on high mountains and in deep caverns, is suited to support various atmospheric pressures. Some have ascended to high elevations, others have descended into great depths with safety. That he might suit his planet, man endures various temperatures. Those accustomed to warm climates, have penetrated into polar regions with perfect impunity. The flexibility of the human economy and the efficacy of human contrivances, guard man against destructive extremes. Habit soon accommodates the human constitution to new situations; and human ingenuity provides for every season, and for every climate.

II. The human foot, like courses of stone in masonry, is composed of three arches, which secure stability with the requisite motions. The waving column which arises from a series of alternate curves in opposite directions, distributes gravity with such nice precision, that the line of direction which passes through the curves, allows motion to the upper extremities without impairing the general equilibrium. The head, the receptacle of the mental organs, moves around with freedom; and the bones of the arm roll over each other with surprising celerity. The steps in walking and the

strokes in laboring, fall in regular measure; and the disposition of the muscles to accord with time, adds considerable pleasure to music and aids the effect of melody. The human hand, a subject of admiration in all ages, is suited to grasp artificial tools, to execute artistic processes, minute elaborations, and a thousand serviceable actions.

Articulate speech fits man for laboring in society. The expulsion of air impinging upon ligaments, produces those vibratory motions which constitute the human voice. Vowels are expressed by the mere emission of sounds; consonants, by the collision of the tongue against the mouth, lips, and teeth. Many thousand words, distinguishable by the sense of hearing, are associated with mental affections, and communicated by oral language. Sound is modulated by organs without much alteration in the vocal orifice, and as speech differs very little in acuteness, the gentle play of so many organs, renders familiar conversation a pleasant exercise. Singing, which, on the contrary, requires a perpetual activity of certain muscles, is a laborious operation occasionally employed to diversify human joys.

The human face expresses mental emotions with such energy as to attract his species by love, or to repel them by hatred or scorn. The instinctive language of the features, a language of the highest importance as well as of the widest comprehension, is perpetually interpreting the mental emotions. The various emotions of the mind call into action certain muscles, and the predominating passion stamps upon the countenance a corresponding impression. In the

attractive affections, the features are soft and pliant; in the repulsive, tense and rigid. Dimples, smiles, sparkling eyes, the softened outline, indicate tranquillity and repose; tears, sighs, frowns, paleness, erections of the hair, indicate sorrow and tempests. The lungs, the heart, and the chest, participate in working up these expressive changes in the features.

III. From the brain, or the spinal marrow its continuation, proceed a vast number of nerves, which make their way to all parts by separating into imperceptible fibres. The nerves keep up a perpetual communication between the sensorium and the remotest extremities. A change of the mental organ, produced by some external cause, is followed by a mental feeling; and new perceptions arise as often as an alteration originating in an organ of sense, is transmitted to the origin of the affected nerve. The senses are the fingers of the mind, feeling its way outward, and opening the shutters to the invigorating light.

1. The sense of touch, connecting man with surrounding nature, is placed at the organic extremities, and exposed to contiguous influences. A gentle friction of an external body, transmits an impression through the nervous system, producing analogous alterations in the mental representations. Touch, which is sensorial power in its simplest form, is diffused over the whole surface, and exists in great delicacy in the fingers. It reveals extension, figure, moisture, softness, smoothness, and temperature. It warns us of an atmosphere which contains too much caloric for the body to endure with safety.

2. The sense of taste is seated in the tongue, which

is kept soft and pulpy by continual warmth and moisture. As soon as certain substances touch this delicate organ, the mind perceives some distinguishable flavor. The papillary membrane, from its exquisite sensibility, performs its pleasurable office; and the elegant organ, seated at the entrance of the alimentary canal, has a direct relation to the motive and digestive organs. The flexibility of the tongue brings it into contact with gustable substances; and the structure and disposition of the digestive organs, determine proper aliments, which the sense is able to detect with corresponding nicety. Nature invites us to food, both from hunger and from the pleasurable feelings attending a repast: salubrious food is connected with agreeable flavors, and the sense guides us with instinctive force and vivacity.

3. The sense of smell is executed by a soft papillary membrane, which lines the nasal cavities. The surface is enlarged by cavernous appendages, and prominently exposed to odoriferous action. Exhalable effluvia are carried to widely naked and extremely soft nerves. As taste guards the entrance to the alimentary, smell to the respiratory canal, "food must undergo the scrutiny of both the senses." Fixed particles are distinguishable by taste; volatile ones, by smell; and some, by their united testimony. Olfaction informs us of noxious putridity, excessive acrimony, and salubrious substances. Putridity, so injurious to the human system, is discovered at a distance; and an atmosphere impregnated with noxious vapors, is guarded against by the olfactory sense. The miasmata of marshes and the effluvia of infected places, are noxious

principles too fine for chemical analysis. The infected air of a hospital, the odor of which was intolerable, possessed, according to Seguin, the same chemical constitution as other atmospheres. Refreshing odors resuscitate from faintness, but acrid perfumes excite numerous antipathies.

4. As the organ of hearing is constructed for attending to atmospheric vibrations, the waves which flow into it are collected on mechanic principles.

Vibratory particles form alternate arches, rising up from an agitated surface. A very sensitive membrane is stretched over bones in the auditory passage; and the sound which passes through the narrow tube, is augmented by new resonances, which are excited by the percussion of elastic cartilages and bones. The resonances mingle with the primitive tone, which, after its last reflection in the auditory passage, forces the elastic membrane to vibrate. The vibrations agitate the aqueous fluid which surrounds the nervous pulp, a contrivance for moderating too powerful impressions. The sound reaches the expansion of the auditory nerve, which conducts it to the common sensory. Distinctions in sound arise from the difference of the velocities of the vibrations, which, being repeated thirty times in a second, become distinctly audible.

5. The organ of vision is fitted up for perceiving colors. A ray of light passes through a uniform medium in right lines; and a white beam emerging from certain mediums, is separated into seven permanent rays. The eye, consisting of refracting substances contained in appropriate integuments, is constructed upon these optical principles. The visual rays pass

through the humors of the eye; and the image of external bodies is painted on the retina, a continuation of the optic nerve. That distance which confines the image to the least possible space, is the point of distinct vision; and the organ is constructed for adjusting the lenses to suit various distances. The image which is painted on a soft white membrane, is conveyed a long distance in perfect darkness through an opaque body to the common sensorium.

The different senses, as intellectual avenues, possess very different powers. Touch, which gives so many perceptions, is so confined in its operations as to converse only with contiguous bodies. Taste has a very contracted sphere, producing few sensations with boundless modifications and combinations. Olfaction acts only at moderate distances; and odoriferous sensations, so energetic in action, are reducible to classes with much indistinctness, and recollected with considerable difficulty. These sensations, so numerous and diversified, possess so few contrarieties or resemblances that language, with the exception of a few generic terms, designates them by the names of the substances producing them, as "the smell of a rose, of a jessamine, of a geranium." The generic terms, moreover, were borrowed from other classes of sensations; but as the terms are sufficient for common purposes and scientific investigations, the poverty of language is a positive advantage.

These three lower mediums of information, conduce to human preservation, and afford pleasure in their appropriate exercise. As Nature condescends "to throw perfumes" with a liberal hand, smell has a con-

siderable share in numerous gratifications. "The fragrancy of the fields enters largely into that" "delightful group of images, which rise in our mind on the mere mention of the names of spring, summer, and the country." Fragrancy "seems to represent the very forms of etherial beauty," "the very breath of heaven itself," "that vernal joy which renders the season of blossoms almost a new life to ourselves."

The sense of hearing possesses considerable amplitude, affords many classible modulations, and cements social intercourse. The ringing of bells has been heard ninety, the eruption of a volcano, nine hundred miles. The "ear is capable of distinguishing four or five hundred variations of tone in sound," and "as many different degrees of strength." The combination of these gives "above twenty thousand simple sounds, which differ in tone, or in strength, supposing each tone to be perfect." "The same tone is susceptible of a boundless variety of modifications. A flute, a violin, and a French horn, may all sound the same tone, and be easily distinguished. If twenty human voices sound the same note, there will be some difference. The same voice, while it retains its proper distinctions, may be varied many ways, by sickness or health, youth or age, leanness or fatness, good or bad humor." To this sense we are indebted for the existence of verbal language, the medium through which man is dignified as a social being.

Divine benevolence has prepared a "sylvan minstrelsy." The note of the wren, "as slender as its form," is heard to the greatest advantage amidst frosts and snows. Migratory birds, at the return of spring,

heighten, by the novelty of their appearance and the variety of their notes, the charms of the verdant scenery. A general chorus, continued under different leaders, awakens us "at dawn," enlivens us at noon, and softens "our feelings at nightfall." The voice of the robin, "in sweet accordance with the feeble beams of the early twilight," "seems longing for the day to unclose." As soon as the glorious sun appears, the lark mounts up, "pours forth his vigorous song," and calls "a thousand warblers to his aid." The nightingale "protracts his nocturnal tones;" "the thrush, the blackbird, and the goldfinch," "intermingle their rival pretensions;" and "the transient but mellow burst of the cuckoo, adds a richness to the general harmony." While the matin is pleasing us with its delicate notes, "the croak of the raven and the chattering of the daw, only break into the symphony" to heighten the impression. "The season of rest returns" not "with mute silence." The solitary "robin resumes his modest strain," "yielding in succession to the peerless pipe of the nightingale, and the deep-toned but expressive hoot of the owl." The night is thus soothed with a soft, sweet, and solemn serenade.

From the sharpest musical to the fullest sublime tone, lies an almost boundless range. The chirping grasshopper, the rippling rill, the pattering rain, the murmuring brook, the purling stream, the rattling hail, the moaning forest, the leaping cascade, the roaring cataract, the howling tempest, the rolling thunder, the groaning volcano, excite diversified feelings. The tolling of a bell or the striking of a clock, is peculiarly awful amid darkness, solitude, and silence. The Tema-

nite, when "deep sleep falleth upon men," when "fear came upon" him, when trembling made his "bones to shake," was agitated with the deepest emotions. The hair of his "flesh stood up," and a spirit whose "form" he "could not discern," passed before his face, and "stood still." "An image was before" his eyes, and there was silence as he "heard a voice saying, Shall mortal man be more" "pure than his Maker?"

Vision, man's noblest sense, "fills the mind with the widest variety of ideas, converses with its objects at the greatest distance, and continues the longest in action without being tired or satiated with its proper enjoyments." It reveals a beautiful variety of sea and land, shady groves and purling streams, variegated flowers adorning delightful gardens, gay enamel painting verdant fields, and gorgeous drapery vesting magnificent forests. It enraptures the mind with elegant shrubs, towering cliffs, and azure skies. Like a diffusive and delicate touch, it "spreads itself over an infinite multitude of bodies, comprehends the largest figures, and brings into our reach some of the remotest parts of the universe." It clears the imagination, disperses gloom, and sets the animal spirits into agreeable motions. It, at the same time, entertains the mind with color, figure, and motion, and roves over grandeur, variety, and novelty, without weariness or satiety.

The prospect of an open country, a vast desert, a huge heap of mountains, an expanse of waters, strikes the mind with peculiar pleasure. A spacious horizon, an image of liberty, permits vision to expatiate freely upon immensity, and to lose itself in unbounded variety. The lofty mountains, capped with everlasting snow,

stand in solitary majesty, or run off in ranges till their tops pierce the clouds. The snow which crowns the summits, beautifully contrasts with the deep blue sky beyond, and with the smoke and fire which ascend from the terrific volcano. On the side of a foaming torrent rises a high wall clothed in living green; and the trees send long tendrils to the stream, as if to carry life back to the huge trunks. A sky adorned with stars and meteors, at night, mingles with the grandeur of a vast troubled ocean.

Creation is decked with colors, the appropriate province of vision, as "supernumerary ornaments." A splendid spectacle is formed in the heavens, at the rising and setting of the sun, by streams of light which show themselves in clouds of different situations. Trees, clouds, and cities, are pictured in the veins of marble, in the fret-work of grottoes, in the magnificent glaciers. The thistle puts forth tubular floscules; the laurel, elastic stamens; and the dahlia, radiated florets of every varying hue. A thousand blushing plants exhibit their delicate minuteness; a few stand forth as prominent pictures in nature's gallery. The crab apple tree, from the peculiar arrangement and wild prodigality of its flowers, appears as a cone of one immense blossom tufted with snow. Animals, eggs, feathers, fruits, and flowers, exhibit elegant curvatures. Rivers meander through valleys, branches undulate in the air, and light radiates from luminous bodies. Ships on the sea, and birds on the wing, describe beautiful curves; and the curling of smoke and flame, is singularly pleasing. The soft swells of the landscape constitute the earth's smile; and color, figure, and motion,

are interwoven in the completest harmony. A landscape variegated by fields in verdure, scattered trees and flowers, gently running streams, grazing animals, bridges with arches, smoke rising from cottages, fine buildings burnished by the rising sun, makes the mind enjoy gay, placid, gentle, and soothing sensations.

Slender trees, gentle streams, gliding birds, are lovely and pleasing; spreading oaks, impetuous torrents, darting lightnings, are magnificent and astonishing. Beauty is penciled on the spangled meadow and the burnished cloud; sublimity, on the gorgeous mountain and the lowering tempest. Majesty is chiseled on the cedar of Lebanon; loveliness, on the trembling tendril which twines around its branches. Cheerfulness is felt in the refreshing shower; serenity, in the bow of promise which displays its beauteous arch on the retiring cloud. The picturesque is enjoyed in dilapidated castles, in luxuriant aloes throwing up blue leaves above the gray stones, in venerable goats perched upon projecting cliffs. The eye, looking around the wilderness for an outlet from oppressive solitude, finds relief in grand, graceful, and splendid scenery. Huge trunks, like the pillars of a vast cathedral, are grouped in elegant arrangements; interlacing branches are moulded into Gothic arches resting upon massy columns; and light snow wreathed into graceful ornaments, adorns the beautiful entablatures. The sun touches the frost-work with a thousand sparkling hues; and the grouped coruscations seem like the tremulous glow of a thousand pendent chandeliers.

Novelty fills the mind with an agreeable surprise, gratifies its insatiable curiosty, and contributes to its

continuous refreshment. "In the opening of spring," groves, fields, and meadows, appear in glossy freshness; and the landscape wears a soft green hue, which, to an eye wearied with the glare of snow, is peculiarly refreshing. The tender grass is springing, the lilacs are budding, and the greater gems are shining so beautifully amid the emerald of spring. The deep purple pansy is nestling in its leaves, the blue-eyed periwinkle opening to the sunshine, the golden vested crocus lifting its brow in mimic stateliness, and the gorgeous tulip rearing its jeweled goblet to the morning dew. The white hyacinth modestly "glinteth forth" its long green leaves, "like a hedge of spears, or the palisades of a fort." "As life and warmth grow strong within its veins," it erects its head, surmounts its guard, and looks around with beautiful feminine dignity. The Ethiopian lily, "so majestic, so superbly fair, so queen-like, so solitary," coils up its new-born leaves as if to conceal some delicate treasure. In northern regions, brilliant meteors are continually playing through the sky. The rays are sometimes white, sometimes yellow, sometimes like the milky way, sometimes like the vivid lightning. The lights appear in irregular arches, separate in every direction, or wave like long bright ribands shaken by the wind. The Indians call these "merry dancers," "the spirits of their fathers moving through the land of souls."

The concurrence of the several senses augments and diversifies the mental feelings. Sublimity is exhibited in the autumnal tempest, when "cloud on cloud majestic piled" envelops the village in misty obscurity, and the

rolling thunder alternates with the vivid lightning. The fisherman loves to look upon the everlasting mountain beetling over his head, to gaze upon the heaving ocean rolling in its mighty waves, to listen to the hoarse voice responding to the spirit of the storm which is glaring and howling through the sky. The cultivated mind is regaled with fragrant meadows, animals feeding with graceful motions, flocks exulting with pleasure, herds lowing in social strains, and lambs sporting with innocent gayety. Green valleys are interspersed with cultivated fields; and "golden harvests gleam along the glassy glade." Every thing seems "profuse with bliss," and overflowing with delight. The "busy bee" displays its painted wings, and utters its grateful hum. "The deep utters his voice, and lifts up his hands on high." The forest emits a piteous moan; the pines wave their heads in solemn reverence. The crackling fire sends up curling columns; and man lifts up his voice in devotional tones. Stately mansions resound with music; clustering cottages, with rural songs. The white clover tops, like snow-flakes melting into the grass, mingle their spicy odor with the fragrant shrubs. Life is in the starting buds, in the swelling turf, in the flower which smiles up towards the deep blue heavens. As the senses rove over "the perspective of distance rounding into a radiant sphere," the mind feels a perfect accord of sights, sounds, and fragrancies, "tuned to melody in every mood and measure."

IV. The mind is enriched with perceptions, some of which are preserved in their minutest characters. Auditory impressions which leave distinct apprehen-

sions, abide with great tenacity; and visual impressions maintain so strong a hold on the mind, that a painter can represent the image of a face upon canvas from memory. Memory comes to maturity in manhood, and decays in old age. The pliant sensory, in infancy, yields, like water, to an impression which is often erased as soon as the external cause ceases to operate. The plastic sensory, in manhood, receives and retains, like wax, the impressions which are committed to its charge; and the vital functions, then in vigorous activity, arrange each one in its proper department for preservation and use. The rigid sensory, in old age, refuses, like iron, to receive new impressions; and recent transactions vanish like the rhapsody of an evening tale, or like the shadows of a cloud flying over frozen fields in a winter's day. Aged persons, by remembering the scenes of youth, are furnished, in dreary age, with pleasing images.

After the storage of primary impressions, intellection comes into play for working up the mental stores into endless varieties. The mind perceives the agreement or diversity of elementary impressions, and discovers their relative proportions or mutual dependencies. As man is connected to external nature by invariable laws, he provides for his pressing necessities, pushes his reason into the nicest relations, and embraces the loftiest systems in his comprehensive understanding. Seemingly formed for immediate destruction, man's elaborative genius soon suggests the secret remedy. The defenceless condition of man is compensated by the nicest intellection, which gives rise to the arts and sciences. The knowledge of in-

variable relations is a medium of mental elegance, of the arts of civilized life, of the continuance of physical existence, which is preserved only by an unceasing adaptation of human actions to external nature. The seemingly rugged laws of nature, learned from hereditary succession or personal experience, are turned to positive advantage. A correct application of science to elaborative pursuits, the last stage of human industry, is a fruitful source of intellectual luxury as well as of pecuniary emolument.

The vast in nature, the splendid in intellect, the lofty in morals, elicits the sublimest contemplations. An awful grandeur agitates the mind while contemplating the Mighty Power that piled up the massy cliffs, rent asunder the mountains, and flung their scattered fragments over the valleys. The mind is amazed at the impulse which launched the masses of the spheres, and generated the harmony of the forces. A mind which grasps at conceptions too mighty for its capacity, is flung into the most rapturous astonishment. The sailor boy trembles at the vastness of his conceptions, when he thinks of the illimitable expanse above, the wide waste of waters around, and the unfathomable abyss beneath. Undetermined prospects furnish elements for speculations upon eternity and infinitude, elements suited for exciting high devotional feelings. The mind is elevated by contemplating the Divine nature, which is uncircumscribed by time or place; which is incomprehensible by the largest capacity.

To contemplate the sublime, in connection with the useful, is a delightful exercise. The glaciers, so magnificent in contemplation, are inexhaustible reservoirs

which melt into water in proportion as the rivers need a supply. Four hundred glaciers lie between Mount Blanc and the frontiers of the Tyrol, and their fullest beauty is only producible by the richest and warmest light, which converts them into refreshing streams. The very heat which illuminates the icy masses, opens up passages resembling magic "towns of ice, with pilasters, pyramids, columns, and obelisks, reflecting to the sun the most brilliant hues of the finest gems." A glacier of the Rhone is described by Bourrit as "a scaffolding of transparent ice, filling a space of two miles, rising to the clouds, and darting flashes of light like the sun." The beholder sees "the streets and buildings of a city, erected in the form of an amphitheatre, and embellished with pieces of water, cascades, and torrents."

Plants, with a peculiar fitness to supply human necessities, are endowed with simple, rich, and variegated beauties. The utility of the flower, which appeals to man's poetic sensibility, is less manifest than its subserviency to his intellectual nature. Nature pours the loveliest charms over the simplest principles of life, and intimately connects the preservation and multiplication of the species with luxuriance and ornament. The blossoms come from a treasury so profuse, that an accidental destruction of a large part, still leaves a redundancy. The root, stem, branch, leaf, and flower, are contained latent in the undeveloped seed, which produces a plant partaking of every parental peculiarity. The several parts appear in due time, and the plant takes an independent stand to become the parent of a multitude. The elegant struc-

ture, the admirable symmetry, the nice adaptation, are made to promote man's physical comfort, intellectual happiness, and moral enjoyment.

A devout study of nature develops the inquisitive mind, and the grateful heart. The floral creation furnishes striking emblems of the Creator's perfection and loveliness, his lofty and benevolent attributes. These frail symbols of infinite Excellence, excite such a strong and electric feeling, that "every tree becomes a hymn, and every efflorescence a song." Reflection passes rapidly from the inert image to the Divine energy, that directs the passive elements into such useful and elegant forms. The models of material beauty which reflect moral loveliness, harmonizes the soul, constrains it to imitation, and calls forth admiration toward that Source of beauty from whence these graceful conceptions emanate. Flowers are stars which glow "in the green firmament of earth," "emblems of the bright and better land." The spring, a season of hope and renovation, excites those calm and deep feelings which are in unison with nature's loveliness. The fragrance which loads the air, the soft petals which fall like foam on the ground, the tender verdure of the grass, the salutations of the season, calm the turbulent emotions, and fill the heart with a fulness of happiness too deep for utterance.

The universe consists of harmoniously arranged series, which the mind passes over with exquisite pleasure. The human body, the perfection of design, has many workshops in continuous operation. The muscles have six thousand intentions, the bones one hundred thousand; and the skin, ligaments, veins,

arteries, glands, humors, and nerves, are arranged in curious conveniency. The few simple laws of matter have their relations multiplied almost to infinity, and the mind delights to carry out a principle to its remotest consequence. The human countenance, so beautiful in lines and shades, exhibits a transcendent beauty in its mysterious expression of intelligence, sensibility, and benevolence. Beauty is inscribed on the purest moral qaulities; and sublimity arises from certain affections of mind displayed in great actions.

Nature coyly witholds her secrets for a time, to secure patient observation, to stimulate laudable curiosity. Physical laws are discoverable with that moderate degree of study which is suited to invigorate the mental faculties. As the sentences are written in hieroglyphics, the meanings must be elicited by diligent observation; but as soon as the true interpretation occurs, the whole line of symbolic characters assumes a definite and delightful symmetry. As perplexity is succeeded by repose, the mind hastens to new explorations. Continuous experience soothes man to wise convictions, and disposes him to salutary serenity in his ardent pursuits. As a thousand mysteries are continually calling for investigation, the obscurity of nature supplies a wholesome and agreeable discipline. "Man lives in a system of approximations," "in a system of suggestions." The orbit of nature vaults into such an unfathomable deep, that human intellect cannot report the return of the curve. Nature, with a failure to yield present satisfaction, keeps up a continuous enticement. The soft beauty of the summer clouds is not so much the present drapery as

an allurement to festive pavilions beyond. Nature is always converting herself into a vast promise, and escorting man through life with anticipative blessings.

The imagination forms fair summers, perfect scenery, beautiful abodes, distinguished honors, cheerful homes, angelic companions, and thrilling joys. It nestles among vines, lays on odorous flowers, and sports among emerald groves. It forms trunks of clouded agate, and leaves of broad emerald, which give forth such a soft chime as to make the air melodious with a thousand fairy harps. Thick vines drop to the margin of pools heavy with emerald leaves, clusters of rubies, and purple amethysts, which shed their various lights upon the pellucid water which sparkles as it flows in soft murmurs through the grove. The atmosphere, as soft and bland as the perfume of a bed of water-lilies, receives hues from the glowing trees and delicate flowers which bloom among the leaping cascades, and flourish among transparent rocks high up on the distant mountains which bound the sight with their gold and billowy purple. In the emerald shade, columns of heavenly sculpture shoot their snowy shafts up among the trees; and temples, with pillars of jasper and domes of fluted pearl, stand in clouds of soft light, which curls upward with a continued silvery smoke. Shaking the rosy light from his wings, man mounts up, in imagination, into the mellow atmosphere, flies among the clouds, floats with a wavy motion, wanders among planets, converses with beings of angelic beauty, and bathes himself in celestial light.

Intellection leaps beyond the sepulchre. The mind, now acting through matter, has a strong presentiment

of its future independency. Physical decay is often attended with intellectual improvement, bodily suffering with mental pleasure, and corporeal sluggishness with spiritual activity. As soon as death snaps asunder the connecting ligature, the body and mind, like two companions who drop conversation, lose each other's company. After putting off the present tabernacle which survives in another form, the mind believes that it can roam with more ease and rapidity. The mind transcends its present existence, abhors annihilation, and exhults in interminable prospects of progressive improvement. Animated with such a glowing expectancy, it grasps after immortality, and longs for celestial scenes. It recoils at a past, but springs with alacrity into a future infinity.

The constitution of nature is suited to develop man's physical and intellectual energies. By imparting a progressive perfection to nature, the Creator has taught us to labor. As materials require amelioration, industry is rendered a necessary and indispensable duty. Man is necessitated to labor for physical existence, intellectual enjoyments, and virtuous affections. Adam, in a state of innocence, was necessitated to labor, notwithstanding his small family, large estate, extensive dominion, high extraction, and contemplative genius. Human life is a routine of care and toil, of familiar pursuits and formal actions, of poetic sensibilities and religious contemplations.

Useful and manly occupations, like a machine brightened by usage, preserves the human body and mind from corrosive injury. The exercise of the muscular frame secures that vigorous circulation, which, in the

alternations of activity and repose, is so healthful to body and mind. That activity which is so pleased in successful pursuits, is followed by weariness, which, while the active powers are sinking to rest, diffuses a feeling almost voluptuous. To this succeeds an impatience of repose; and these alternations, so necessary to health, invite man from stage to stage in his momentous existence Science, the result of mental activity, makes the winds and the waves, the earth and the air, the heat and the cold, the brittle rock and the ductile metal, the fragile flower and the towering forest, minister to human necessities and refinements.

In controlling the wonderful agencies of nature, man acquires a high prerogative, discovers his magic efficiency, and learns his true dignity.

CHAPTER IV.

WANTS.

Human wants give activity to human industry. The world consists of material substances in connection with intellective faculties. The body from the dust and the mind from heaven, are brought into the closest union, and curiously moulded into one. Man calls "corruption" his "father," "the worm" his "mother" and "sister," and angels his anticipated companions. The complicated wants of this compounded nature, calls for continuous exertion; and man, like a boat on a stream, glides swiftly to destruction as soon as he ceases to grapple with nature. Exertions are necessary to supply physical necessities, elegant tastes, literary cravings, religious emotions, and simple consolations. Life has other wants "than to adorn this body which must so soon be wrapped in grave clothes, than to keep warm and flowing the blood which must so soon lie cold and stagnant in the tomb."

Want is bounded solely by the utmost limits of human acquirement. As soon as inferior wants are supplied, noble desires immediately present themselves, and become almost as imperious as those which formerly demanded food for the appetite, or shelter against the inclemency of the seasons. As moderate exertion

satisfies the inferior senses, ample scope is left for commodious architecture, beautiful amusements, and elegant literature. Throughout the delightful circle of surrounding beauty, the mind finds abundant excitement to elicit its utmost activities. In the highest stage of social improvements, the mind needs the science of philosophers, the elocution of orators, the excitements of literature, the sentiments of poetry, the incentives of moralists, and the charms of music, to enhance social pleasures. As man advances in civilization, less labor is sufficient to supply mere necessaries, and lofty aspirations are curious contrivances of nature for prolonging industrial habits.

Want, the comprehensive induction, merges all minor distinctions, and manifests itself in every commodity. Human wants appear in the gratifications provided for the senses, and through them for the nobler mind. The sense of touch requires several artificial gratifications; and the organ of taste, besides its necessary demands, requires considerable artificial refinements. The organ of smell has its peculiar wants; the auditory nerves want their appropriate excitements; and vision demands all the industry which escapes in providing for the other senses. The elaborations, in the following enumeration, will be arranged according to the principal sense which they are designed to gratify, and to those senses which appeal more directly to the mind.

1. To warm the human body, the surrounding atmosphere must be raised to a moderate temperature. Rigorous climates call into requisition the trees of the forest and the coal of the mine, for mollifying human

food, for fortifying the human frame against atmospheric inclemency. Nature clothes inferior animals in dresses suitable to the latitude, and gives man intelligence to clothe himself. The cotton yarn spun annually in England, would encircle the earth's orbit more than eight times, and the manufactured fabrics would pass more than twelve times round the globe. Man, wanting soft beds and clothing, has manufactured fabrics excelling the amaranth in softness. In rigorous climates, he needs shelter for himself and his domestic animals.

2. To acquire food for sustaining life, elicits, in some latitudes, considerable systematic activity. Some flavors produce too much, others too little excitement to the digestive organs. The constitution is more invigorated by the simple productions of nature, than by those monstrous mixtures which stimulate the organs to unnatural activity. Rhubarb tastes pleasant and delicious in tarts; caraway and coriander are useful for medicine and confectionary. Prussic acid, a deadly poison, is agreeable and innocent in very minute portions; and that which exists in peach kernels and bitter almonds, communicates an exquisite flavor to cream or pudding. Salt is a general ingredient in seasoning; and thyme, mustard, onion, garlic and spice, are used for the same purpose. Savory, marjorum, and basil, are wanted for aromatics; sage, balm, and hedera, for tonic beverages.

3. The sense of smell has wants to demand human industry, and like that of taste, receives its highest gratification from moderate indulgence. Notwithstanding the fragrancy which is so profusely spread over

external nature, the olfactory nerves demand artificial perfumery. Food is required to be agreeable to smell as well as to taste; and plants are wanted for perfumery as well as for light, food, and varnish. Salts are made for resuscitating from faintness; and the mints are used as febrifuges, aromatics, and perfumes. The oil of lavender is an agreeable perfume; and rosemary is used in manufacturing Hungary water. Many acres of land are cultivated in roses; and twelve manufactories are in operation for Cologne water in one city. Musk, a small quantity of which is agreeable, is sought after for perfumery.

4. The artificial wants of audition, absorb a portion of man's elaborative industry. It requires vibratory bodies to put the air into certain states for conveying pleasure and information. To the music of the birds, human industry superadds the animating drum, the soft harp, and the mellow organ. The pleasure of sound results from a moderate irritation of the nerve; and sounds are pleasing in very different relations, and with very little accordance. Brittle and tense bodies are required for emitting acute tones; and copper, iron, and tin, are conspicuous for richness and sonorousness. To produce sounds, elastic bodies are put into quick vibratory motion by some sudden impulse. The vibration of a column of air is employed in wind instruments; the vibration of solids, in stringed and pulsatile instruments. Sound is conveyed to a distance by the trumpet, and collected into a focus in the whispering gallery. The operations of the vitals are revealed by the stethoscope.

5. Vision demands a multiplicity of artificial color-

ing. Black, blue, red, and green, the four leading colors, are needed to produce other shades. Black is obtained from oxide of iron with tannin and gallic acid; and the addition of logwood and acetate of copper, imparts a shade of blue. The black oxide of iron gives a dull green to bottle-glass ; sesquioxide of uranium imparts an orange color to porcelain ; and powdered bisulphuret of silver forms the beautiful vermilion. The prevailing tints of vegetable colors are blue, red, yellow, and green, affording unbounded diversity in their mixtures. Blues are made of indigo ; reds of cochineal, lac, archil, madder, Brazil wood, logwood, and safflower ; and yellows, of quercitron bark, turmeric, American hickory, fustic, and saffron. Green is formed on an indigo ground with quercitron bark, and saffron, a bright yellow, is rendered blue, then lilac, by sulphuric acid. Quercitron, with a basis of alumina, communicates a bright yellow ; with oxide of tin, a variety of tints, varying from a pale lemon color to a deep orange. Carburetted hydrogen burns slowly with the emission of a dense white light.

Clothing, which gratifies vision as well as touch, affords ample scope for the highest embellishments. The infant mind is more charmed with the beauty than with the use of raiment, and the passion for the ornamental unfolds itself at an early period in human life. The pressure of necessity calls for rude textures ; and choice conspiring with necessity, prompts man to seek a more comely and salubrious covering. Textures are stained by the infusion of permanent colors, and the pencil is employed to improve the labors of the loom. Of the morbid secretions of animals are manufactured

costly ornaments, those worn as amulets against contagion, those used for imparting additional attraction to personal beauty. For ornamenting his person, man strives to imitate the shell with its brilliant colors, its beautiful spots, and its delicate wreaths. As the art of building is not limited to the construction of comfortable shelters, a large proportion of mechanic industry is expended in gratifying an elegant taste for architecture. An independent habitation serves for the enjoyment of periodic rest. Domestic happiness is promoted by conveniency; public taste, by splendid decorations. Repasts are arranged with order, perfumes are put up in tasteful coverings, instruments of music are finely polished, and machinery is beautifully colored, for visual gratification.

After physical wants are supplied, much industry remains for elevating the noble faculties. Man strives to typify whatever is detrimental or useful, and to connect mind with perceptible forms. The fine arts, being addressed to the imagination and the feelings, aim at the representation of moral beauty and excellence. The plastic arts, which afford pleasure through visible images, employ material forms to express purely intellectual conceptions. They exhibit mental emotions through bodily attitudes and gestures, and through allegoric images and combinations which have ennobled the arts, and elevated them above their original limits. Music and literature, as fine arts, have elevated the human mind to a high moral and intellectual pinnacle.

1. "The very taste of a people" manifests itself "in its architecture, which thus becomes its characteristic

physiognomy." Architecture is a faithful recorder of noble deeds, an index for determining social, literary, and philosophic advancement. It establishes nations, infuses a love of country, encourages illustrious actions, embellishes society with high civilization, and refines the intellectual and moral feelings. It rears altars and temples with splendid decorations and mysterious symbols. Domestic architecture is the offspring of necessity; monumental and sacred architecture proceeds from gratitude and reverence. Want erects the funereal urn of private affection, the monumental marble of historic dust, and the lofty church-spire which gives the mind noble inclinations. The decorations of Christian churches, in their accurate proportions, bold constructions, grand masses, and severe dignity, speak a religious language. In the German churches, slender columns united in groups rise to a lofty height, resembling the giants of the grove under the dark shade of which the ancient Teuton used to build his altar. Such architecture excites feelings of devotion, and displays more symbolic than hieroglyphic eloquence and dignity.

2. Sculpture, when carried to its utmost height of excellence, moves the passions far more powerfully than the finest poetry. "Language, itself, is" "but the type of thought," and "we crave for symbols as the permanent declarations of our sentiments." "Busts and statues are the hieroglyphics of ideas, emotions, and passions." The creed of nations is symbolized in images; and "feelings, passions, and abstractions, beam from the classic statues." Sculpture sheds a peculiar lustre over the pages of ancient and modern

history, affording evidence of national taste and refinement.

3. Painting is wanted for overwhelming the mind with rapture and astonishment. Its range is so comprehensive as to grasp within its scope every visible object in creation. A few feet of canvas portrays a province, with its variety of mountains, rivers, villages, and rural scenery. Painting spreads out the azure deep, "bearing ships and armaments, either gliding gently upon an unrippled surface, or hurled from their anchorage by the booming tempest." It makes "the eye sparkle with intelligence, and the cheek glow with health and beauty." It portrays discord, slaughter, and desolation ; or displays concord, peace, and plenty. It excites the liveliest emotions, and awakens recollections which have long slumbered in forgetfulness. Portia, who bore with fortitude her separation from Brutus, burst into tears at the sight of the picture of Hector parting with Andromache. Alexander, on seeing a picture of Palamedes betrayed to death by his friend, was so struck with the recollection of his own treacherous treatment of Aristonicus, as to exhibit paleness and trembling.

Many vestiges of picture writing appear on the Egyptian monuments. The Mexicans apprised Montezuma of the landing of the Spaniards, by representing the event in pictures on a linen cloth. A memorial was left by a party of American Indians, by tracing pictures with their knives upon bark. They represented an officer, a lawyer, a mineralogist, eight armed men, and three encampments, by drawing one man with a sword, another with a book, another with a

hammer, eight men with muskets, and smoke ascending in three distinct columns. Picture writing has been employed in keeping accounts, by merchants and mechanics.

Such imitations served as symbols, to represent objects which are incapable of imitation by painting. Many invisible things were indicated by visible signs. The eye was a symbol of providence, the bird an emblem of swiftness, the scaling ladder a representation of a siege. Pictorial imitations were abbreviated, and arbitrary signs obtained definite meanings by conventional usage.

4. Mosaics, which consist of pieces of clay, marble, glass, and precious stones, have the various colors and shades so arranged as to form visible representations. One hundred and fifty pieces were sometimes contained in a superficial inch. Mosaics can be polished without affecting the colors, and are not as liable to injury as paintings. The art was most in vogue in the time of Claudius, and Sosus was the most celebrated artist.

5. Musical tones, in their pure and simple state, have something in their nature which is truly heavenly and delightful. All delightful sensations are capable of being heightened by the power of musical sound and poetic numbers. The nursery wins the child's attention to the simplest, and, at the same time, the richest truths, by means of sacred song. "After the association has passed away in the turbulent scenes of life, the little hymn chanted by the fond mother comes rushing in upon the mind in all its original freshness." Music becomes the handmaid of virtue, in softening and elevating the feelings, in ennobling and purifying

the whole character. The mind, when enkindled by the excitement of music, is rendered more enlightened, penetrating, and vigorous. Conscious of its acquired force, it utters greater sentiments, conceives higher designs, and performs nobler actions.

6. Man, by nature, is both a musician and a poet. The same impulse which prompted a certain melody, produced a poetic style suited to the emotions of grief, joy, love, or anger. Music and poetry are united in song, and assist and exalt each other. Language, the machinery of poetry, even when employed by such artists as Homer or Dante, does not present as lively images as statuary and painting. Poetry, on the contrary, has a much wider range than the plastic arts. These arts can only exhibit that small portion of human passion which flows into the face and gestures; but the deeper and complexer parts of human nature can be exhibited by words alone. As poetry conducts the imagination over the face of nature, the vicissitudes of fortunes, the whole external and internal universe, its imperial domain is commensurate with the imaginative faculty.

The mind which is insensible to single impressions, requires collective forces to arouse its dormant sensibilities. Tragedy is needed to convulse the soul with passion and emotion. Vivid impressions of every variety invest the mind with sparkling vivacity and glowing brilliancy. The coldest nature is animated, the firmest heart is moved by the rapid communication of the prevailing impulse. The words which proceed from a heated imagination, transmit a contagious sympathy, which becomes a powerful instrument of per-

suasion. Intense and fervid impulses inspire us with the sublimest emotions, but temporary enthusiasm soon subsides to those calmer passions which are better suited to our present circumstances. Passion hurries us to opposite extremes; reason glides us along a pleasing mediocrity. Intellectual conceptions which are adorned with the gayest colors of the imagination, sometimes excite a momentary glow; but among a polished people, a taste for poetry is rather an amusement of the fancy than a passion of the soul.

7. Primary impressions, being associated with vocal sounds or visible images, recall past conceptions without presenting the original scenery. Words are used for naming things, for instituting comparisons, for expressing actions and relations. Language advances to connectives or words of transition, which contribute so largely to perspicuity and elegance. For regulating human actions, language employs words for expressing cause and effect. The invariable relation of antecedence and consequence observable in physical actions, is stated in language for regulating human industry. Invisible sentiments are described, abstract propositions are rendered intelligible, and all the conceptions which science can discover or imagination form, are known by their proper names, or embodied in visible characters. Language, by an artificial method, becomes a vehicle for transfusing the most delicate emotions of one mind into another—an instrument of the most refined luxury. Language fixes the points gained in the interpretation of nature, and applies the interpretations to human embellishments. It entertains the fancy, adorns social intercourse, unfolds the mental

faculties, ameliorates the human condition, dignifies humanity, and lifts the human mind to lofty contemplations.

Speech and writing, each having its appropriate province, are fully adequate for human instruction. Hearing and vision possess a sympathy so intimate, that the ear is delighted when the eye passes over harmonious language. The genius of gifted minds, the flowing eloquence of the impassioned orator, transmit their sweet influence into kindred minds. As tones, looks, and gestures, are the natural interpreters of the sentiments, oral language has a superiority in perspicuity and impressiveness. Besides removing ambiguities and enforcing impressions, the voice of the living speaker operates by sympathy, and the high effects of eloquence are made by spoken language. Vocal language is local and fugitive; visual language is extensive and permanent. By written characters, man sends his thoughts to distant regions, and records instructive transactions for distant ages. As written characters are before the eye, the reader can arrest the sense of the writer, can pause, revolve, and compare at leisure.

The statues of illustrious personages crumble; the images of knowledge, being capable of perpetual renovation, remain exempted from temporal desolations. The copies of statues lose their truth and grace; writing preserves a portraiture of the soul in imperishable colors, and gives a page more elegant than the original manuscript. The verses of Homer have continued without loss for ages, while palaces, temples, and cities,

have fallen into ruins. Jeremy Taylor, like Ninus of whom he wrote, is "a little heap of dust," but his name is still held in lively remembrance. The author who makes his words a link between the past, the present, and the future, is the lord of three mighty realms. Without the pages of the historian, the very names of the heroes of other days would be extinct. The historian builds up again the ruined cities, and calls up thronging nations from the dust. He prevents man from remaining in infancy, and the past from becoming a dreary blank, an abyss of annihilation. A ship which carries commodities, associates the remotest regions, while letters, the ships of mind, pass through the vast seas of time, and make distant ages participate in former illuminations and inventions.

Written language prevents the irrecoverable loss of primary impressions—enlarges the mental vision—and preserves the tone of the mind in elastic vigor. Without such artificial help, the human mind soon dissipates or corrupts the impressions entrusted to its charge, and the faculties, no longer supplied with models or materials, gradually forget their respective offices. The imagination becomes languid and irregular; the judgment becomes feeble and lethargic. The use of letters is the principal circumstance which distinguishes a civilized from a barbarous people. Without some species of writing, no people have preserved the faithful annals of their history, made any considerable progress in the sciences, or possessed, in any tolerable degree of perfection, the useful and agreeable arts. Before the art of writing came into gene-

ral use, traditon, the only mode of preserving remarkable events, had loaded history with a mass of facts, fictions, and fables.

The love of letters is almost inseparable from social and philosophic refinement. The manners of ancient or modern nations, are depicted in those studies which gratify literary taste and curiosity. The student multiplies his experience, lives in distant ages, and converses with remote countries. He transfuses himself into the mental states of others, and is continually delighted with grandeur, beauty, and novelty. Systems transmitted through successive generations, exercise the powers, and enlarge the limits of the human understanding. Literary accomplishments are afforded to multitudes, continuous exercise is given to endearing relations, and human life is furnished with its most exalted pleasures. An exile from his native home receives consolatory information that his family still holds him in affectionate remembrance.

History opens up various pleasures to the imagination as well as to the understanding. The philosopher, whose ruling propensity is the love of knowledge, finds perpetual gratification in tracing the streams of science to their original fountains. An unfailing source of pleasure arises from remounting to the origin of that systematic beauty which adorns civilized life, and from discovering the gradual steps in the transition from uncultivated nature to the present artificial refinement. As many steps in the progress were made before men began to record their transactions, it is not always possible to trace the methods which have improved the arts and sciences, or to observe the chain which has

conducted the human mind from the first rudiments to the highest improvements. As the dews of the morning are past, it is in vain to continue the chase in meridian splendor. The history of objects in the misty distance, accustoms the mind to pleasing contemplations. Letters conduct the philosopher to an eminence, and exhibit to him the gloomy picture of humanity softened by science, which loves to repose under laurel bowers and olive shades.

Literary pleasures, being the purest exertion of the intellect, elevate the spiritual and permanent above the corporeal and transitory. Human happiness essentially consists in exerting the higher faculties, in acquiring mental treasures, in diffusing science through society. Literature warms, stimulates, irradiates, embellishes, refines, elevates, develops, and matures the intellectual faculties. It has a high moral tendency, and receives a uniform encouragement from an enlightened philanthropy. It supplies those sources of enjoyment which withdraw the mind from unprofitable and corrupting pleasures. It possesses the greatest novelty, affords pleasure which increases with indulgence, and gives to weariness its most agreeable excitement, relaxation, and amusement. It drinks at the purest springs, cultivates the highest talents, nurses the noblest purposes, and converts solitude into the most delightful society. The grace of language and the elegance of writing are genuine and manly beauties. Such studies, acute but not painful, profound but not abstruse, strow flowers in the path of science, and relieve the mind in its toils after profound erudition.

Civilized life is instructed by science, regulated by written laws, and consoled by Divine revelation. Christianity diffuses intelligence among the mass, and leads the commonest mind to the noblest pleasures. As soon as the mental soil is saturated with celestial dew, it quickens into vegetation and life. Christianity exhibits the grandest scenery to excite our awe, and the tenderest incidents to rivet our sympathies. It leaves the imagination to brood "over the immense abyss," a vastness which confounds the perceptions and exalts the affections. It throws over life the creations of inspired genius, the heavenly aspirations of hope, and the splendid idealities of poetry. It diffuses a lustre over the path of human life, exhibits the image of rectitude in its sublimest forms, comprehends the seeds of endless improvement, clothes morality with Divine sanctions, harmonizes virtue with humanity, and unites the loftiest speculations with the deepest humility.

Education is an extensive want, a preparation for man's various duties and destinies. As fast as a people acquire sentiments, a language is invented commensurate with their mental advancement. To apprehend the meaning of language, the mind must feel the sentiments which the symbols are intended to indicate. Elegant literature creates a fresh impulse for the mechanical and agreeable arts. The press must work with greater rapidity to satisfy the growing want, and with greater accuracy to give more beautiful copies. The neatest typography which art can execute, and the finest engravings which genius can suggest, are needed

to convey literary pleasures to the understanding and affections.

By the aid of language, particular facts are arranged into a scientific classification. Want requires the sciences of medicine, arithmetic, astronomy, geometry, geography, and metrology. Pebbles and seeds were first used as helps in enumeration, then written characters indicating numbers, various traces of which appear upon the earliest Egyptian monuments. The facts of astronomy are needed in navigation, in civil regulations, in agricultural labors. Chronology is wanted to give order to events, and contrivances are adopted for imparting coherency to numbers Geometry is wanted for mensuration; geography for commerce; and metrology for estimating property.

8. Science mingled with devotional sentiments, prepares the mind for the deepest impressions. By the aid of various contrivances, the mind enters so far into the genius of nature as to explain many attractive operations and beauties. Rising in lofty abstractions above this little theatre of human passions and anxieties, the mind sees the traces of Deity invested with wisdom, benevolence, and majesty. The dimensions, distances, and revolutions of the planets, are pleasing contemplations and useful studies. The reason of Galileo and Newton took as sublime a flight as the fancy of Ariosto and Milton. As the cloud begins to dissolve, the majestic simplicity of creation inspires a feeling like awakening into a higher existence, like approaching to a nearer intercourse with its benevolent Author. Science removes perplexing intricacies, dubious hallucinations, and uncertain guesses. The mind,

in perceiving the harmonious contexture of truth, its apt coincidences, and its secret junctures, enjoys the highest vitality, the strongest energy, and the mightiest plenitude. Such studies, being honors gained without crime and enjoyed without remorse, adorn as well as dignify humanity, give an elegant employment to leisure hours, and contribute to the purity and innocence of domestic life.

Improvements in science and art afford a pleasure to the understanding, fully compensating for the pains employed in their acquisition. Botany, in its rich parterre, has opened a new source of admiration in its elegant metamorphoses. Art, not so magnificent as nature, exhibits its nice touches and splendid embellishments. The great elaborations of genius are imitations of nature, representations of human characters, actions and manners. The understanding is gratified by comparing the copy with the original, as well as charmed with its intrinsic beauty. Artistic pursuits afford intellectual instruction and rational amusement. Not content with a simple communication of thought, figures give coloring to the abstractest conceptions. Figurative language sets mirrors before us, and the mind beholds objects a second time. It entertains us with a succession of splendid pictures disposed in artificial lights and shades. All language is strongly tinctured with metaphor, which insinuates itself into familiar conversation. The mind is exercised in discovering resemblances, and gratified with its own ingenuity.

9. The mind has one entire faculty for ornament. "The imagination is the flower of the mind, which

crowns the intellectual tree with beauty and glory." The flower is necessary for fruit as well as for beauty, so the ornamental branches of education conduce to usefulness as well as to mental embroidery. As a plant buds before it blossoms, so ornamental education is long pursued before it displays its beauty, or discovers its usefulness. In the wild fields of nature, the imagination roves without confinement, and is furnished with its most delightful furniture. The mind alters or compounds the images called up by paintings, statues, or descriptions, and forms them into the most agreeable combinations. Imagination awakens the faculties, gives them gentle exercise, and conduces to health and cheerfulness. The fancy uses figurative language to paint its delicate workings. It plays between two similar objects with pleasure, and contemplates them without confusion or embarrassment. The imagination has converted language into a pliant and flexible instrument for expressing the most delicate and refined sentiments.

"Man is a noble animal, splendid in ashes and pompous in the grave." With melancholy fondness, he expects his grave to be adorned, and that a profusion of crape will swell the tide of splendid woe. It is congenial to the feelings of the living mourner to retire to the grave, to weep in the solitude of nature, to commune with the spirit of the tomb, to lay the offering of affection at the shrine of the dead, and become happier by venting a pleasing melancholy. The survivors ornament the tomb with shrubbery that spring may invite the young by the "opening foliage," and autumn "detain the contemplative by its latest

bloom." The votary of science learns "to elevate his genius by the holiest studies;" the devout, "to offer up the silent tribute of pity, or the prayer of gratitude." "The rivalries of the world" "drop from the heart;" "the spirit of forgiveness" gathers "new impulses;" "the selfishness of avarice" is checked; "the restlessness of ambition" is rebuked; vanity lets "fall its plumes;" and pride sees "what shadows we are, and what shadows we pursue."

CHAPTER V.

ELABORATION.

Man supplies his wants by operating upon existing materials. As materials do not exist in that arrangement, figure, or location which want requires, human elaboration is necessary for human support and embellishment. Man's province is to ascertain Nature's mode of operating, and, by artificial means, to secure a recurrence of her desirable operations. Man brings materials under the influence of natural agencies, and causes the mechanism of nature to work out the most magnificent results. Human inventions are humble imitations of the grander machinery which displays itself in the planetary system, in the elegant functions of animated nature. Industry combines substances into new modes, forms bodies into new figures, and removes commodities to distant locations. It clears forests, cultivates lands, builds habitations, computes time, measures spaces, calculates magnitudes, levels mountains, traverses seas, constructs telescopes, and appears in stupendous and ornamental magnificence.

I. The elective affinities enable the chemist to purify mixtures, to separate compounds, to form useful medicines. By grinding, heating, and agitating,

he gives the affinities liberty to act. From a solution of camphor and alcohol, he obtains camphor in a solid state; and from acetate of lead and sulphate of zinc, he obtains acetate of zinc and sulphate of lead. Corrosive acidity and acid bitterness form substances distinguished for mildness; and elements, in one proportion, give a useful medicine; in another proportion, a deadly poison. The chemist extracts a crystallized mineral from animal hoofs, a black dye from "worn-out coal scuttles," sugar from linen rags, and nutricious bread from saw-dust.

Electricity is accumulated in jars, and lightning conducted to the earth. It makes bells ring, figures dance, and substances crack with a brilliant deflagration. The galvanic battery, an effective instrument in the laboratory, has large plates to increase electric quantity, numerous ones to augment electric intensity. Galvanism makes dead animals leap, and sometimes restores suspended animation. Human bodies are agitated in every muscle, laborious breathing returns, the chest heaves, smiles illumine the face, the arm extends, and the forefinger points as if addressing a multitude.

Caloric, a tremendous agent, is shut up in furnaces, made to labor and act as a docile servant. It is employed to reduce refractory substances, to overcome cohesion which seems to defy every other agency. It serves to prepare food, to warm habitations, to smelt ores, to soften iron, to harden clay, to extract brilliant substances from the rudest mixtures. Coal and iron ore, long frowning upon each other on opposite mountains, yield to "the hot blast." A stream of hot air

makes the ore give up its treasure, "like the traveler in the fable, who only wrapped himself the closer at the cold wind, but could not resist the sunshine."

1. The elaboration of metals, which exert such an important influence towards human civilization, exhibits, in a striking light, man's happy ingenuity. The metals, so disguised in ores, are separated from impurities by delicate and complicated operations, and wrought into useful tools, ornamental vessels, and elegant furniture. Iron comes into play in cultivating the earth, in navigating the sea, in constructing efficient machinery. The ore, which is stamped into powder, is put into a furnace with appropriate fluxes; and when air is sent in by powerful machinery, iron runs out like water. The hot metal is rolled to render it malleable, carbon is restored, the steel is hammered into blades which are tempered with water and polished on swiftly revolving stones.

Clay is softened with water, moulded into required forms, and hardened in the furnace. After the clay is comminuted by machinery and agitated in water, the coarse particles subside and leave a pulpy consistency, which is poured off for further subsidence, and then passes through a series of sieves of successive fineness. Pounded flint being added, the mixture is evaporated to a proper consistency for shaping on wheels, or casting into moulds. The design is executed with a pencil, or taken on paper from an engraved plate with a color which is transferred to the vessel. The vessel, after being dipped in a silicious solution, receives, by an exposure to caloric, a vitreous coating. Amianthus is used for making vessels less liable to

fracture; and porcelain is formed of very delicate clay with silicious earths, which impart a semi-transparency by vitrifaction.

A mixture of sand and alkali melts into a liquid mass, which is converted into glass by blowing, casting, or moulding. Beautiful colors are made by various oxides, and ornamental forms are impressed by metallic moulds. The glass is so ground as to leave figures as if made by a sharp-cutting instrument. It is polished by revolving wheels covered with emery or putty. It admits light into cottages, and makes mansions sparkle with mirrors, tumblers, and decanters. It restores the feeble vision, furnishes transparent vessels for chemical experiments, and affords instruments to trace the movements of the stars, to explore the minute recesses of vegetables, to ascertain the functions of myriads of animated beings.

2. Agriculture, which is chemistry conducted on a large scale, converts the coarse earth into vegetables for human sustenance and comfort. The ground is plowed, harrowed, and tilled with appropriate machines. As plants cannot rove about in search of food, man must supply appropriate nutriment, when it is deficient in the soil. Many substances, like salt or spice for animals, are wanted to digest food for plants; and light, caloric, and electricity, are encouraged as stimulants to hasten vegetable action.

Tillage renders the earth friable for the insinuation of the roots, the penetration of moisture, the evaporation of excessive water, and the access of the atmosphere. Incoherent silica is corrected by adhe-

sive alumina, and a small portion of carbonate of lime corrects the faults of both the earths. Soils are loosened by plants which send down radicles, and loose soils are rendered fit for use by binding them with fibrous or creeping roots. Tillage destroys weeds, renews the surface, and incorporates manures. By these operations, the latent elements acquire the properties necessary for transmission into plants.

Tillage gives a slope favorable to drainage, prevents aqueous stagnation, and diffuses moisture through the whole mass. Silica is unsuitable for absorbing and retaining the necessary fluids, and evaporation forms alumina into lumps separated into fissures. Carbonate of lime, by closing the pores of silica and opening those of alumina, increases the absorbency of both, and corrects both with respect to defective and excessive detention of moisture. A soil thus corrected, draws moisture in dry weather, resists evaporation from gentle rains, and keeps moisture at the roots to enable the plant to perform its proper functions.

Minerals prepare food for plants, and give form and firmness to their textures. Silica, alumina, and carbonate of lime, are the order of abundance in fertile soils. Lime, in some form, is necessary for supporting plants, and a considerable abundance of it is required for clover and sainfoin. Humic acid, which is found in manures, combines with lime, and enters into plants by the root fibres. As lime hastens decomposition and brings manures into action, it is adapted to lands which contain inert organic matter, which, in cold climates, forms moors and bogs.

Vegetable manures loosen the soil, and, during

fermentation, impart a genial warmth. Guano produces from forty to seventy times as great a growth of plants as an equal quantity of common manure. Animal manures afford much nitrogen, which is necessary to plants, and a principal constituent in wheat, cabbage, tricoli, turnips, and radishes. Wheat which grows on a soil well supplied with nitrogenized compounds, possesses the largest amount of the nutritive principle. Nitrogen which is taken up by plants from salts, increases the number of seeds as well as the amount of nutritive gluten. Manures are so mixed as to enable plants to appropriate enriching elements as soon as formed, and to postpone the final decomposition to the proper period for use.

Manures increase acidity, which proves highly injurious to cultivated plants. Acidity retards decomposition, and prevents soils from using their actual resources. Lime neutralizes acidity, destroys acid plants, and gives cultivated vegetation a healthful activity. As long as a superfluous portion of the carbonate of lime remains in the soil, lands do not become acid by applying putrescent manures. As soon as a soil assumes an acid character, the agriculturist produces calcarosity by artificial applications. Carbonate of lime, because it forms neutral salts with acids, is sometimes supplied for ages by nature without calcarosity. Artificial applications, after the carbonate of lime is neutralized by acids, require a renewal.

Silica allows the gases which are not segregated by vegetating plants from manures, to escape into the atmosphere. Alumina delays the dissipation as well

as the use of manures; and aluminous soils, by denying admittance to fertilizing ingredients, derive, before cultivation, very little benefit from enriching depositions. The carbonate of lime forms new combinations with organic substances, and no manure can escape as long as the combination lasts. These combinations are dissolved only by growing plants, which take nutriment from them as easily as from other compounds. Carbonate of lime, like mordents in setting colors, fix fleeting manures in the soil; for, by combining with manures, it becomes a connecting link to combine them with silicious and aluminous earths. "Every pound of ammonia which evaporates, is a loss of sixty pounds of corn." Ammonia is retained by sulphuric acid and nitrogen by burnt clay, till they are wanted by growing plants.

Plants derive their color, taste, and nutritive qualities from light; and caloric is required for germination, growth, and maturity. The agriculturist gives the surface an inclination towards the sun for promoting light and caloric, and avoids this disposition when there is a tendency to parch for want of moisture. A pulverized texture receives caloric, and prevents evaporation which occasions cold. The fixing of manures darkens the color, and increases the absorption of caloric from the solar rays. Pine straw, being a good conductor of electricity, promotes vegetation. Grape vines are sometimes furnished with conductors; and the galvanic battery, which expedites vegetation, is used on a small scale.

As different portions of the soil are abstracted by different plants, the agriculturist institutes a beneficial

rotation. The substances rejected by one family are greedily devoured by a succeeding crop of a different family. Pruning fruit trees ameliorates the quality, or increases the quantity of the fruit. Man, according to his purpose, makes the stem prosper more than the foliage; the foliage, more than the fruit; the fruit, more than the leaves. The color of a pink is changed by a ferruginous soil, and celery acquires its delicacy by its exclusion from light. Italian corn is sown thickly on a barren soil, to give the straw that morbid delicacy and slender form which render Leghorn hats so fine and elegant. Man "has changed the crab into the apple, the harsh sloe into the delicious plumb, and the bitter brassica into the delicate cauliflower."

3. Food, by chemical operations, is rendered agreeable or beneficial to the human system. Organic substances are so treated as to soften their fibres, to extract or dissolve their nutritive or exhilerating principles, or to effect an entire change in their chemical constitutions. Papin's digester extracts gelatine which is taken on long sea voyages. To preserve organic substances from decomposition, watery particles are expelled, the atmosphere excluded, oil, sugar, acid, or salt applied, or frigorific mixtures used to prevent the action of the elective affinities.

Fermentation, which tends to destroy human food, is turned to advantage in making bread, beer, cider, and wine. Machinery is employed to mix meal with water, to knead the mass, to roll the dough, to form the biscuits, and to pierce them for the bakery. In baking, the carbonic acid which is detained by the tenacity of the dough, heaves up the mass to a porous

consistency. The liveliness of beer is owing to carbonic acid generated by fermentation. Fermentation is arrested at one point for wine, at another point for vinegar. By distillation, volatile principles ascend in vapor, and condense into oils.

II. Man reduces the wisest animals to servitude, uses flocks for elaborating flesh and wool, and employs bees for forming wax and honey. The elephant suffers itself to be arrayed in harness, takes pleasure in its fine trappings, and draws chariots or shipping with evident satisfaction. The camel labors, besides furnishing milk and flesh, and hair for clothing. The feet of the dromedary are as soft as sponge, so as not to be hurt by stones or sand. The lama of Peru, a beast of burden, eats little, and yields very fine wool. Pigeons are trained up in Turkey and Persia to carry expresses.

1. Caloric, by expanding bodies, becomes useful in various mechanical operations. The tire is heated before it is put on the wheel; so, also, the rivets which bind together iron plates for boilers. The expansibility of metals is employed to draw in walls which have lost their perpendicularity. The iron bars which are extended across the building, are heated by lamps, and while thus elongated, the nuts on the projecting ends are screwed up close to the wall. The bars, on cooling, contract with such force as to draw in the walls to their required position. Blocks of marble more than eighty feet long, are separated from the mass by a sudden change of temperature. Grooves are cut at required distances, fires are kindled upon the mass, water is thrown into the cavities, and the rock splits "with a clean fracture."

By alternately converting water into vapor and vapor into water, man obtains an efficient motive power. Steam, by its introduction into a cylinder, drives a piston before it, and, at the same moment, the steam is condensed and another portion introduced on the other side, to force the piston to its former position. These alternations are continued, and the piston communicates motion to machinery. The power depends on the intensity of the steam, and the magnitude of the cylinder. The efficient force of an engine which permits the steam to escape, is the excess of the pressure of the steam above that of the atmosphere. An engine with a condenser is cumbrous, and requires much water; an engine without a condenser has simplicity and lightness, qualities suitable for locomotive purposes.

Gunpowder rends vast masses asunder, and firearms give man dominion over the aërial and terrestial inhabitants. Rocks are dressed out in long cylinders with horizontal indentations, into which are driven wooden wedges, which, by exposure to moisture, expands with such force as to subdivide the cylinders into mill stones. The absorption of moisture accomplishes "an operation, which, from the peculiar hardness and texture of the stone, would otherwise be impracticable, except by the most powerful machinery, or the most persevering labor."

The thermometer measures temperature by the expansion of mercury; the pyrometer, by the contraction of clay. Human ingenuity avoids the injuries which expansion inflicts. The irregularity of clocks, occasioned by the expansion of the pendulum,

is corrected by using bars of different expansive powers; and, by the use of different metals, a compensation is made to secure uniform motions in watches. Vessels of glass, to stand fire, are made so thin as to expand almost simultaneously on both sides. Steam-pipes are suspended by iron rods, so as to give play to expansion and contraction without impairing the stability of solid edifices.

The elasticity of the air is brought into play in human contrivances. A continuous pressure is obtained from the intermittent strokes of the fire engine, and water is thrown upon the devouring flame in a continuous stream. In the air-gun, the force, on being released, acts simultaneously, and equal to the separate efforts made during compressure. Condensation treasures up a great number of separate exertions, and such magazines are sometimes formed by inanimate forces to be ready for practical uses. On the principle of elasticity is constructed the air-pump, an instrument much used in experimental philosophy. By exhausting the air from vats, the process of tanning is performed in a few days.

Mechanical agents are used in altering the figure and locality of substances. A series of cars are connected by flexible springs so as to communicate motion successively to the whole train, and, on the contrary, a sudden blow is given to rocks so as to separate fragments before motion is communicated to the whole mass. Small bodies, as hammers or flails, are made to move with great velocity for producing an instantaneous and powerful effect. Grain is introduced be-

tween millstones at the centre, that the centrifugal force may carry it to the circumference.

Gravity is employed in various machinery. The weight of a clock serves to overcome resistances, and to render the motions of the pendulum permanent and isochronous. A stream of water flowing upon a wheel, imparts motion to effective machinery; and by forming a vacuum in a pump, the pressure of the atmosphere becomes a force for raising fluids. From the pressure of fluids, Bramah constructed the hydrostatic press, an instrument of such prodigious force that "one no larger than a teapot" "cuts a bar of iron as easily" as "a slip of pasteboard."

A plumb line is used to ascertain levels, and to give perpendicularity to buildings. On the principle of fluids at rest, depends the construction of leveling instruments; on the principle of pressure, depends the construction of fountains for spouting fluids and conveying water into cities. The purity of coins, drugs, liquids, and chemical preparations, is ascertainable by specific gravity. "Instruments are constructed for detecting adulterations; as the oleometer for oil, the lactometer for milk." The pressure of the atmosphere sustains mercury in the barometer, an instrument for measuring elevations, for indicating pressures which precede storms.

The steam-engine so much resembles an animal, that no mere work of man approaches so near to actual life. Heat is the principle of its existence, and the boiler acts the part of the heart, from which its vivifying fluid rushes copiously through the tubes. The fluid, after discharging the various functions of life, returns

to be duly prepared for another circulation. The healthfulness of its action is indicated by the regularity of its pulsations. It procures its own food, selects the suitable parts, and evacuates the useless ingredients. It cures its own diseases, corrects its own irregularities, and exerts something like intellectual faculties.

2. Man, as a "tool-using animal," renders the mechanic powers available. His club and bow are levers, his knife and arrows are wedges. He aids his muscular force by applying a bar to raise a rock, and counteracts the gravity of a heavy body by forcing it up an inclined plane. With a block and cord he forms a pulley to draw water out of a pit. An inclined plane, wrapped spirally round a cylinder, is a screw which he uses in building a tower. He uses hammers, scissors, cranes, capstans, grindstones, axes, chisels, coulters, and spades. With such contrivances, he moves large masses slowly, and small ones with great velocity. He changes the alternating piston to a rotary motion; the rotary motion to the alternating saw. The tilt hammer moves rapidly while the iron is hot; and the operator is suspended so as to move a long blade in quick succession over the anvil. The fly-wheel and the governor impart uniformity to motions.

Machines treasure up separate efforts for powerful action, or, as in the case of the watch-spring, expend the accumulated force in gentle operations. Machinery, by enabling man to use his feet as well as his hands, increases his efficiency many fold. It employs inanimate forces which execute operations transcending human power and dexterity. It supersedes the

hand itself, and performs operations with more precision than its intelligent contriver. With the lathe man turns circular boxes, oval frames, rake handles, boat oars, and sythe snaths. From the same copper plate, he obtains the equality of impressions in their minutest traces. Sulphur, when set in train with nitre, air, and water, goes on "through a labyrinth of compartments," till it sends forth sulphuric acid for commerce. Machinery saves materials, abridges time, and keeps such a register of its own operations, as to preclude human negligence and dishonesty. It measures the quantity of gas consumed, and the goods as they pass from the operators in manufactories.

For acting upon the divisibility of matter, man constructs implements for disintegrating rocks and pulverizing the soil; mills for triturating paints and grinding corn, for boring cylinders and sinking shafts, for sawing timbers and separating slabs, for rasping wood and chipping wheel teeth; machines for granulating lead and making coal gas, for threshing grain and heckling flax, for grinding cutlery and forming lenses, for splitting skins and dividing whale bones, for planing boards and cutting key-grooves, for turning bowls and shearing cloth. Impenetrability allows the construction of sugar, oil, and cocoa-nut lard mills. Permeability is employed in filtering apparatus for refining sugars and purifying oils; ductility, in gold beating and laminating mills; fusibility, in iron and brass foundries; crystalizability, in manufacturing saline substances.

The filaments of asbestos are soaked in oil, mingled with cotton, spun upon the spindle, woven into cloth,

and cleansed with fire. The bark of the daphne is drawn out to resemble lace, and sometimes used for ladies' dresses and gentlemen's cravats. The leaf of the pine apple is manufactured into a texture which is superior in brilliancy, softness, and beauty, to the finest cambric. The spiral fibre of cotton, which intertwines with an easy, elastic force, is well adapted for spinning. It has long, slender filaments, and possesses fineness, strength, evenness, and freedom from knots and entanglements. A pound of cotton was spun into a thread of two hundred and thirty miles in length. Of the ornamental beard of a silk worm found in the Indian seas, the weavers of Palermo manufacture glossy stuffs or silky textures.

Tortile fibres are interwoven into plains, twills, gauzes, or laces. In velvet, plush, and Turkey carpets, the threads are drawn up and cut so as to form a soft uniform nap. In Marseilles quilts and ingrain carpets, two webs intersect at certain intervals to produce a definite figure. In tapestry, the warp is concealed by the filling which is introduced to give the fabric a fine and ornamented surface. The down on cotton textures is removed by burning; and woolens are scoured to restore roughness to the fibres. Compression in water so promotes the entanglement of woolen fibres as to thicken the web. Carding with a bur raises a nap which is sheared off an even surface.

"The perfection of automatic industry is to be seen" in the cotton mill, in which "the elemental powers have been made to animate millions of complex organs, infusing into forms of wood, iron and brass, an intelligent agency." "The cotton," says Baines, "is passed

through the willow, the scutching-machine, and the spreading-machine, in order to be opened, cleaned, and evenly spread. By the carding-engine, the fibres are combed out, and laid parallel to each other, and the piece is compressed into a sliver. The sliver is repeatedly drawn and doubled in the drawing-frame, more perfectly to straighten the fibres, to equalize the grist. The roving-frame, by rollers and spindles, produces a coarse and loose thread, which the mule, or throstle, spins into yarn. To make the warp, the twist is transferred from cops or bobbins at the warping-mill to a cylindrical beam. This beam, being taken to the dressing-machine, the warp is sized, dressed, and wound upon the weaving-beam. The latter is then placed in the power loom, by which machine, the shuttle being supplied with cops of weft, the cloth is woven."

"The operations are numerous, and every one of them is performed by machinery, without the help of human hands, except merely in transferring the material from one machine to another. It is by iron fingers, teeth, and wheels, moving with exhaustless energy and devouring speed, that the cotton is opened, cleaned, spread, carded, roved, wound, warped, dressed, and woven. The various machines are proportioned to each other, in regard to their capability of work; and they are so placed in the mill, as to allow the materials to be carried from stage to stage, with the least possible loss of time. All are moving at once, the operations chasing each other; and all derive their motion from the mighty engine, which" toils "with the strength of a hundred horses."

Coloring matter, through the play of the elective affinities, is removed from textures, to increase their beauty, to fit them for dying and ornamental designs. Bleaching is performed by light, chlorine, or sulphurous acid. Textures are exposed upon a grass-plat to the sky, with an occasional aspersion with moisture. Modern art employs chlorine, an agent modified by chemistry, with astonishing rapidity, economy, and perfection. Wax is bleached by an exposure to air, light, and moisture; flax, hemp, and cotton, by bleaching powders in alkaline solutions; and wool and silk, which are hard materials to bleach, by sulphurous acid gas. Wool is relieved of its fatty matters by an alkaline solution; and ivory black, a powerful decolorant, is used in refining sugars.

Dying is accomplished by the play of the affinities between the liquid and the fibrous texture. Dyes owe both their permanence and depth of shade to the intensity of the attractive forces. Wool, plunged into a certain solution, assumes a scarlet hue; cotton, only a feeble pink tinge. By varying the preparations and processes, modern art, with the same or different stuffs, obtains an indefinite variety of colors, of variable solidity and shade. Some mordents, without possessing any color, serve merely as a bond of union between the dye and the fabric; others not only fix but modify the dye, by forming an insoluble compound which is deposited within the textile fibres. Mordents act through a series of transformations, so as to vary colors, increase their lustre, and give them durability.

Linen, which possesses little affinity for coloring

matters, is sometimes stained with colored designs. Cotton webs, after singeing bleaching, and smoothing, pass to the printing machine, which is constructed with great elegance and complexity. "The engraved cylinders," says Ure, "are mounted upon a strong iron shaft, or arbor, carrying a toothed wheel at its end, in order to put it in train with the rotary printing machine, for one, two, or more colors. On a roller, at the upper part of this apparatus, are wound whole calico webs, stitched together, the end of which is then introduced between the engraved copper cylinder and a large central cylinder, covered with a blanket, against which it is made to bear, with regulated pressure. The engraved cylinder turns on the top of another cylinder, covered with woolen cloth, which revolves within the former, while its under-part is plunged in an oblong trough containing the dying matter, which is of a pasty consistence. The engraved cylinder is thus supplied with an abundance of impressible color, and is cleared from the superfluity by the edge of a flat ruler," "which is applied to it, with a gentle force. The cylinder, after its escape from this wiping tool, acts upon the calico, and rolls it onwards, with its revolution, imparting its figured designs with great precision."

Fibres are formed into paper, principally by pressure. The rags, after dusting by a wire cloth, are cut by a machine into fillets, which, after another dusting in a revolving cylinder, are washed in water to carry off the remaining impurities. "The rags begin to be torn, at first, with considerable agitation of the mass, and stress upon the machinery." The pulp, after

receiving a stream of chlorine gas, is transferred to the beating engine, supplied with size and matter, and reduced to a uniform consistency. It is "received in a continuous stream upon the surface of an endless web of brass wire, which extends round two revolving cylinders, and is kept in continual motion forward, at the same time that it has a tremulous, or vibrating motion." The continuous sheet is wiped off by a revolving cylinder covered with flannel, and by successive operations, is compressed, dried, polished, and cut into finished sheets.

By casts, man obtains articles exactly similar. The figure on cast iron is a copy from a previous pattern. The engraver draws his designs upon plates with a sharp instrument, or by admitting an acid upon the required parts. The lithographer selects a stone which will not imbibe ink, and draws his design with a composition which adheres to the slab, and attaches the printing ink. As the ink adheres only to the composition, a paper pressed upon the stone receives a perfect transcript. "In galvanic engraving, the shaded lines are raised, being deposited from a solution of copper on a plate of the same metal, by means of galvanic electricity." Copper plates, with depressed lines, are copied by the galvanic process, and the number of copies multiplied to any desirable extent. Medals are multiplied with distinctness and facility, by this curious mode.

Small wheels and holes which require identity of size, are made by punching, a species of copying. This method furnishes golden stars, apertures in colanders, and plates of rosewood which decorate

ornamental furniture. Wires are drawn through circular holes; and pinions for clocks are formed and burnished, by passing through the required aperture. Tubes for astronomical purposes and lead-pipes for the conveyance of water, have a triblet passed through the interior surface. Iron is rolled for sash frames and ornamental mouldings. Ornaments upon medals, buttons and nails, are made by stamping. A pattern is engraved on rollers, and the substance to be embossed is passed through to make a raised pattern.

Moveable types, for printing, are copies made by castings from copper moulds, which are copies made by steel punches copied from other punches. From the ordinary types, a transcript is taken in plaster, from which another copy is taken in metal. From the stereotype plate comes the printed page, the sixth copy from the original. Sheets are sometimes printed by the power press on both sides by the same operation. "The printers of the London Quarterly Review have, in operation, in one establishment, nineteen machines, each capable of printing a thousand sheets an hour." Sometimes a continuous "sheet of paper passes directly into a printing machine;" so that unsightly rags, deposited in a vat, comes out printed sheets.

Maps are printed and colored at one operation by machinery. A printed page, or a picture, is transferrable to the lithographic stone, from which copies are printed to an indefinite extent. Any number can be printed from the reversed fac-simile, "without the slightest tarnish to the original print, or the least

diminution, in any way, of its clearness or depth of color. The whole is done with such facility, that a page has been taken from a volume, transferred to a stone, several copies printed from it, and the leaf restored to its place, in its original state, in sixteen minutes."

A process of copying is thus described by Babbage: "A cylinder of soft steel, pressed with great force against the hardened steel engraving," receives "the design, but in relief. This is, in its turn, hardened;" "and, if it be slowly rolled to and fro, with strong pressure, on successive plates of copper, it will imprint on a thousand of them a perfect fac-simile of the original steel engraving from which it resulted. Thus the number of copies producible from the same design, is multiplied a thousand fold. But even this is very short of the limits to which this process may be extended. The hardened steel roller" "may be employed to make a few of its first impressions upon plates of soft steel, and these, being hardened, become the representatives of the original engraving, and may, in turn, be made the parents of other rollers, each generating copper plates like their prototypes. The possible extent to which fac-similes of one original engraving may be thus multiplied, almost confounds the imagination."

The architect, aiming at the accommodation of successive generations, selects the most durable materials, disposes them in the most secure situations, and applies cement according to the uniting medium. Masonry and carpentry are executed upon such nice principles, as to make gravity contribute to stability.

The architect supports columns upon inverted arches, secures the points exposed to pressure, and gives materials the required strength with the least possible matter. Domes have massive walls to support the incumbent gravity, and bridges have arches made in that form which is best suited for resisting lateral pressure. The stones are dovetailed in the light-house of Eddystone, a structure which was copied after a branchless oak. Rules of beauty are derived from ostensible utility; the most beautiful column is the form best suited to support the incumbent mass. The painter gives buildings soft and quiet shades; such as fawn, grey, or brown. Neutral tints contrast agreeably with the prevailing hues of nature around them. In proportion as a house is exposed to view, its hue is darker; and where it is much concealed by foliage, it has a very light shade.

The speaking trumpet throws the reflected vibrations into the direction of the vibrations which proceed strait forwards. In the whispering gallery, the whole of the vibrations are collected at a focus. The microscope produces a magnified image, and the telescope enables us to view distant bodies at a greater visual angle. Mirrors, with a focus of six feet, magnify as much as a lense of a hundred feet. With such effective instruments, man examines minute bodies, and measures the ponderous globes which are ranged in majestic order through the skies.

Marble is used for statuary; mica, for dead lights; mica slate, for flagging; porphyry, for splendid and enduring architecture. The fibres of flax contribute to clothing; the oil, to medicine; the rags, to litera-

ture. India rubber is used for shoes, roofs, gasholders, and surgical instruments. The bamboo is used for making masts, boxes, houses, fences, palanquins, and wrappers for tea. The aloe serves for beams, covering for houses, quavers, ropes, nets, thread, cordage, bow-strings, fishing-lines, stockings, hammocks, clothing, sugar, wine, vinegar, medicine, dye, painting colors, resin, and varnish. The milk of the cocoa-nut is a delicious beverage; the soft fibres of the tree are made into fine cloth; and the leaves, like slates or shingles, are formed into roofs for houses. The flesh of the seal is used for food; its fat, for seasoning and light; its fibres, for sewing silk; its viscera, for harpoons and window lights; its bones, for various implements; its skin, for serviceable clothing or ornamental drapery.

"The neat paling which fences" the dwelling of "the cottager," says Gordon, "was sawed by steam. The spade with which he digs his garden, the rake, the hoe, the pick-axe, the sythe, the sickle, every implement of rural toil which ministers to his necessities, are produced by steam. Steam bruises the oil-cake which feeds the farmer's cattle, moulds the plowshare which overturns his fields, forms the shears which clip his flock, and cards, spins, and weaves the produce." "Stone is cut by it, marble polished, mortar mixed, floors sawed, chimney-pieces carved, lead rolled for roofs and drawn for gutters, rails formed, gratings and bolts forged, paints ground and mixed, paper made and stained, worsted dyed and carpets woven, mahogany veneered, door-locks ornamented, curtains and furniture made, painted, and measured;

fringes, tassels, and bell-ropes, chair-covers and chair-nails, bell-wires, linens, and blankets manufactured; china and earthen-ware turned; glass cut, and pier-glass formed." "The drawing-room, dining-room, kitchen, pantry, and closets," "owe to steam their most essential requisites." It clothes man in "excellent broadcloth;" makes "boys rejoice in a plurality of suits;" and "busks the bride" "in robes, delicate in texture as the spider's web, beautiful as the rainbow hues." "It plaited her bonnet, tamboured her net, wove her laces, knitted her stockings, veneered her comb, flowered her ribands, gilded her buttons, sewed her shoes, and even fashioned the rosette that ornaments their ties."

III. The gravitation of the globe permits many commodities to be transmitted by animate power. The ass moves over precipitous roads with ease, under a load which a horse could not carry with safety. The camel, the ship of the desert, conveys commodities over sandy plains; and its peculiar feet, its long abstinence, and its internal reservoir for water, are admirable contrivances for passing over dreary regions. Oases, like fertile islands in a dreary ocean, furnish resting places and water for caravans.

Noble rivers, running at convenient distances asunder, are highways for transporting commodities. The ramifications of the ocean, the windings of its coasts, the maritime features of geography, though seeming deformities, are arranged for commercial intercourse. The ocean, viewed by the ancients as a separating bar, is a uniting link to the remotest nations. Navigation

has connected the social ligatures of those fragments which formerly existed in the profoundest barbarism. A ship, supporting heavy burdens, travels more than two hundred miles in a day upon a ready highway. The action of the winds, depending upon the equilibrium of temperature, moves ships upon the mighty deep. On the coast of America, the trade winds are felt as far as forty degrees from the equator. A vessel sailing from Mexico to the Philippines, often finishes a voyage nearly equal to half the circumference of the globe, in sixty days, without altering its course or changing a sail. Steam propels ships with safety across the broad Atlantic, with almost as much exactness in the time of arrival as a mail between two contiguous towns. By the mail from India, intelligence is received in England in little more than two months.

Friction is reduced by wheels, the axle of which "glides very gently over a smooth surface in a gently waving line." An animal can draw still more in a canal boat; and the shape of the boat has been conformed to the swiftness of its motion. Almost every part of the United States is now traversed by railroads. The railroads of England sometimes pass under, sometimes over cities. Expresses have been carried at the rate of sixty miles an hour.

Modern philosophy has lengthened life, mitigated pain, and extinguished diseases. It has enabled man to descend into the sea, to soar in the air, to penetrate into mountains, and to carry lights into explosive mixtures. It has increased the fertility of the earth, given new security to mariners, and spanned rivers

and estuaries with stupendous bridges. It has multiplied the power of human muscles, accelerated motion, almost annihilated distance, facilitated friendly correspondence, and fraternized inimical nations. It has extended the range of human vision, lighted up the night with splendor, and fixed the human image on the mirror. It has enabled man to whirl along the earth without horses, and to drive mighty ships against winds and waves. It has used the luminaries of the heavens to guide man over the trackless ocean, and discovered the magnetic needle which guides him safely during lowering skies and midnight darkness. It has guided the thunderbolt innocuously to the earth, used the electric fire in the laboratory, and endowed the globe with sensitiveness.

CHAPTER VI.

CONSUMPTION.

THE necessity and pleasure of consumption give energy and direction to human industry. The periodic return of hunger, the inclemency of the seasons, the violence of diseases, compel man to consume. Man also consumes in pleasing the senses, the avenues to the understanding. As soon as a commodity loses its arrangement or figure, a new series of labor is necessary to cause its remains to excite pleasurable sensations. The degrees of consumptive rapidity are all merged in the comprehensive induction. Some commodities, such as food and oratory, perish with present enjoyment; other commodities, such as sculpture and coin, retain their pleasurable attribute with the utmost tenacity.

The commodities consumed upon the three inferior senses, are generally rapid and final consumptions. Perfumes, flavors, and heat, are evanescent, or continuous only by destroying chemical arrangements. Such fugitive enjoyments resemble those angels which, according to Rabbinical tradition, are generated every morning in paradise, fill up the day in continual song, and sink at evening into their original nothingness. Oratory, the nice modulation of sound,

is consumed by the rudest as well as by the most cultivated nations. The pleasure of sound, so transitory in sensation, leaves an abiding impression upon the human understanding. Visual commodities, though they often require a great original expenditure, are generally slow in consumption. A jewel, though a very costly embellishment, delights successive possessors with its attractive brilliancy. A small expenditure in literary treasure, extends enjoyment over an interminable period; and the human mind, in the purely spiritual world, will receive its vestments of light on as cheap terms as the lilies.

Nature produces alternate extinctions and formations; so necessity compels man to obtain prospective supplies by consuming existing commodities. As nature has its reviving and consuming vicissitudes, so human industry causes a series of accumulations, and a series of extinctions. From consumption itself, like a phenix from its ashes, arises a new commodity in a more ornamental or necessary form. As annual consumption is about one-fifth part of existing elaborations, the whole equivalency is consumed twenty times in a century. This vast consumption is more than replaced in every improving country, which, after supporting its inhabitants, adds a surplus to existing resources. The progression or retrogression of every country, is determined by the proportion between its elaboration and consumption. The alternate series of elaborations and consumptions, often sweep a large circle before the commodity finally satisfies a human want. The alternations, so changeable in particular variety, move over a continuous series like the gyra-

tions of a spiral line, the coils of which do not return into each other at successive repetitions.

He who casts his "bread upon the waters," finds "it after many days;" and one "scattereth and yet increaseth," while another "withholdeth more than is meet, and it tendeth to poverty." The total elaborations possessed by the whole human family, is the proprietary reservoir which contains a support for man till the fruits of each season are brought to maturity. A store is laid up for future consumption, the destiny of every commodity. The hope of future gain preserves a portion for aiding future elaboration; and the lucrative affection makes a provision for the scarcity of an unfavorable season. The mind consecrates, as in a purifying sacrifice, momentary gratifications to lasting enjoyments.

For the consumption of seeds and manures, the farmer receives a greater equivalency in cultivated plants. Several commodities are entirely consumed, and other commodities undergo a partial consumption in providing food "which perishes with the using." The implements of husbandry, the kitchen furniture, the shelter for domestic animals, are exemplifications of partial consumptions. Granaries are gradually consumed in storing fruits; mills, in grinding wheat; ovens, in baking bread; and fuel, in culinary processes. Fences are expensive investments, sometimes costing more than the whole farm is worth. The cultivators of Europe, by employing shepherds, save a vast expenditure, the land on which the fences stand, and the accumulation of soil thrown up to them in tillage.

More than fifteen million quarters of wheat are annually consumed in Great Britain; and the malt which was made into beer, in one year, exceeded forty million bushels. In England alone, more than fifty five thousand acres of land are cultivated with hops for making beer. England annually consumes thirty million pounds of tea, five hundred million pounds of sugar, twenty million pounds of coffee. The number of animals which annually comes into the Smithfield market, exceeds a million and a quarter; and it is supposed that ten times as many are consumed in the whole kingdom. The United States raises one hundred and sixty-six million pounds of tobacco, ninety-six million bushels of wheat, four hundred million bushels of corn, and seventeen million tons of hay. In the market of Cincinnati, during the season, one hundred bushels of strawberries are daily sold. On one route, twenty-five thousand cattle have been counted going to the New York market; and it is computed that forty-five million pounds of meat are annually consumed in the city.

Feathers and furs are consumed for clothing, and provender is consumed in rearing sheep for wool. An expenditure is incurred in procuring hides; hides are consumed in making leather; leather, in making shoes; shoes, in providing nutrition for the animals affording the hides. The vast labor incurred in providing cotton, is consumed in fabricating cloth which is consumed in comfortable garments. Manufactories, as well as fixtures for manufacturing in private families, are solely intermedial expenditures. Machines, though expensive, repay the expenditure with profits.

A pound of cotton lace has been sold for a hundred guineas; and textures, with their beautiful colors and elegant embroideries, are doomed to destruction.

England, in one year, consumed six million pounds of silk, one hundred and seventy million pounds of flax, six hundred million pounds of cotton, and two hundred and sixty million pounds of wool. Fifteen million yards of bagging, for the express purpose of packing cotton, were manufactured in the United States. More than eight hundred million yards of cotton fabrics, thirty yards to each individual, are annually consumed in Great Britain. The consumption in hats, caps, bonnets, and shoes, amounts, in the civilized world, to several hundred millions annually. England manufactures annually fourteen million pounds of soap, and fifty million hides and skins.

Economy in building depends on the proper adjustment of present expenditure to future durability. A cheap cottage soon disappears; a sumptuous mansion continues to gratify successive generations. The Pantheon, a very costly edifice, stood nearly twenty centuries; and the massive pyramids have survived the dynasties of the Pharaohs, the Ptolemies, the Cæsars, and the Caliphs. The Parthenon, which was constructed at an expense of more than five millions of dollars, withstood, for more than twenty-two centuries, the ravages of time and political revolutions. It was used successively as a heathen temple, a Christian church, and a Moslem mosque. Thebes, after the desolations of more than two thousand years, exhibits its magnificent temples, tombs, sphinxes, and obelisks. One hundred thousand workmen, according to Hero-

ditus, were employed for thirty years in erecting a pyramid. The three greater pyramids mentioned in the sacred books of the Hindoos, are called "mountains of gold, silver, and precious stones." The architectural excavations at Salsette required, according to the calculation of an artist, the labor of forty thousand men for forty years. That portion of the Alhambra built by the Moors, is in excellent preservation; and a large portion of the splendid mosque of Decca, the most beautiful architectural monument of India, is still perfect.

Thousands of years have elapsed since the sepulchres of Thebes were decorated, yet the colors are as vivid as if they were but freshly painted. "After three centuries of spoliation," Pausanias "found in Greece three thousand statues," and describes "one hundred and thirty-one paintings." The paintings found in Herculaneum and Pompeii, though buried for seventeen hundred years beneath the lava of Vesuvius, retain their original freshness and beauty. The statue of Minerva stood for many centuries in the Parthenon. The garland of the daughter of a Saxon nobleman, had minatures of beautiful flowers painted on vellum, and subscribed with poetic effusions. It was once sold for fourteen thousand five hundred and ten livres.

Consumptions made for canals, roads, and shipping, conduce to increased elaboration, and diffuse plenty over once barren regions. The canal of Languedoc employed, in its construction, twelve thousand men for fifteen years. Great Britain has twenty thousand merchant ships, three thousand miles of canal, and twenty-five thousand miles of turnpike

road. These large consumptions have had ample remunerative advantages. In the beginning of the present century, communication in the Highlands of Scotland was attended with difficulty and danger, and the inhabitants used crooked sticks with iron points, in tillage. As soon as the roads made these interior parts accessible to the more civilized, better implements, more improved tillage, and superior moral habits, immediately followed. Wild and neglected plains in Ireland, were connected by roads with improved districts, and the inhabitants soon exhibited a pleasing spectacle of tranquility, industry and economy.

The consumption of medicine is an intermedial consumption, which returns in physical strength and activity. The medical profession, by preserving valuable lives, has increased elaboration, and, by removing or mitigating various diseases, has prolonged the average of human life by several years. Medicine often stays contagious maladies, which consign the most intelligent and enterprising men to an early sepulchre. To avoid the loss of human life, a loss so painful to private affection, is a most judicious and benevolent expenditure.

As man has much to fear from the passions of his own species, he must consume in supporting government. The city watchmen who apprehend very few aggressors, prevent an amount of depredation which exceeds all estimation. The officers of justice, by rendering property secure, conduce to the support of millions, and give confidence to the variegated operations of human society. A good government induces the citi-

zens to make permanent investments in great and profitable pursuits

An expenditure for promoting piety, has copious and elegant returns. Christianity has an immediate advantage as well as a remote influence. By unveiling a future world and expanding the limits of human existence, it tends, in a proportionate degree, to augment the grandeur and enlarge the sphere of human agency. Immense advantages are derived from it to every clime, where it prevails in its purity. It has contributed to give Europe and America a prodigious superiority over Asia and Africa. It rises, like a finer sun, to quicken moral vegetation, to replenish humanity with embellishments, to curb the fury of the passions, to form public manners from reverential duty, to infuse tranquility by an implied confidence of security from unbridled ferocity.

Literary consumptions return in improved arts and sciences. Affixing syllables to roots, gives richness and harmony, and expresses various modifications of thought, without tedious circumlocutions or incommodious appendages. For the want of proper inflections, the Chinese are unable to avail themselves of European arts and sciences. Science, by literary assistances, has reared its head to the heavens. Literature facilitates science by giving precision to words, and permanency to thoughts. The language of poetry, by imprinting itself with energy, retains philosophic precepts with facility; and, at an early period in history, legislators, priests, and philosophers, adopted poetry as the language of instruction. In the lowest servitude and depression, the Byzan-

tines possessed a language for unlocking the treasures of antiquity; and its revival, after an oblivion of several hundred years, diffused a purer style of composition, excited a more rational strain of sentiment, and caused the arts and sciences to flourish in Europe.

To consume in philosophic investigations, is an elaborative facility to enlightened nations. As the cultivation of one science improves those which are contiguous, the benefit returns in many contributary streams. The close affinity which the ancients supposed to exist among the muses, is apparent among the sciences. Every advantage which is conferred upon a single member, advances the whole family. One science furnishes instructive analogies for another; and the remotest facts often lead to brilliant discoveries. The path of science, when first smoothed in its lower steps, is easily ascended to its summit. A minute penetration into the laws of nature, rewards man with noble discoveries; and laborious inductions exemplify the beautiful simplicity which emerges from a seemingly entangled mass. Many sciences are now in general use, many others are fast coming into notice, and many experimentalists are solving the grandest problems.

The arts derive benefit from science, and from their own close affinities. The moderns, dealing in comprehensive principles, are carrying the benefits of induction into every pursuit. The arts which were the offspring of necessity, have been improved by science; and a casual hint often leads tó inventions which produce results beyond human calculation. Art some-

times precedes science; but, even in that case, science rolls back upon art with redoubled energy. Modern science substitutes intelligence for physical force, and accomplishes the grandest purposes by mechanical contrivances, or by chemical agencies. Vegetable physiology promotes medicine, agriculture, and the useful arts. It teaches the best mode of applying healing substances, of managing plants, of fixing the most brilliant and unfading dyes. It enables us to preserve skins, to correct noxious acidity, to counteract virulent poisons. By the science of animated nature, acids are extracted from animal secretions, and a most beautiful dye is furnished by an insect. The usefulness of the bee, silk-worm, and Spanish fly, is a prelude to many useful qualities which genius may yet discover among the insect tribes. Fossils furnish cement, fertilize the earth, and mitigate autumnal fevers. Since chemistry has taken rank with the sciences, art has pressed forward with the most rapid strides. The new companionship of science and art is still accomplishing the happiest and most profitable results.

The physician has become acquainted with the functions of the human body, the nature of diseases, and the properties of medicinal substances. He examines elementary tissues, and their mode of union, the vital organs, and their mutual dependencies. He discovers diseased manifestations, the mechanism of disordered actions, and the particular ingredients which are deficient or excessive in the fluids. He learns the mode of administering chemical remedies, of conforming to unexpected vicissitudes. He knows what medicines

may be administered together with safety, and learns the hidden movements from the condition of a single secretion. He is enabled to arrest the successive undulations of disordered actions, before they recede too far from the first point of agitation, before their mutual influences expand throughout the whole economy.

The improvement in the art of working metals, has resulted from machinery and chemical agents. The mass of cinders accumulated during seven centuries, is no more than that which accumulates around a modern furnace in as many months. A single furnace makes seventy-five tons of iron a week, enough for three million knife blades. To render the iron malleable, requires a far greater force than the unaided strength of every man in Britain. Machinery with inanimate forces is employed, "without which no one could obtain a spade for less than the price of a year's labor." Nations without science, though ore is abundant, are without iron. "Without thinking and inventing, all the men that ever lived could never procure it; and without machinery to lighten the labor, no ingenuity could procure it at a thousand times the expense." The cast-iron annually manufactured in England, is six hundred thousand tons.

Glass was sparingly employed in the windows of private dwellings until the seventeenth century. Only a century ago, many houses in England and the United States were lighted through paper, horn, or mica. Tumblers and decanters now ornament tables in the place of pewter cups and stone jugs. Rude nations dry their vessels in the sun; civilized nations beau-

tify them with elegant paintings. Less than seventy-five years ago, England manufactured only a small quantity of the coarsest crockery, now she exports annually forty million pieces, many of which are of a very fine quality.

Agricultural chemistry relates to living plants, to the spontaneous changes of organic substances, to the chemical conditions which are essential to vegetable life and development. Each acquisition derived from the lessons of nature, is a prelude to further attainments in its complex and concordant workings. As the nature of soils, animals, and vegetables, is investigated from every available information, civilized society is beginning to profit by organic chemistry. The pathway from the laboratory to the plantation, is trodden in modern times; and a small expenditure in the art of agriculture, returns with accumulated profits.

A century ago, the fields in Scotland yielded scanty crops, and manufactures scarcely existed. Oats and barley were alternately sown; and the best soils were ravaged by sheep, which required the richest pastures. After seed time, the farmer was employed in weeding his fields, and providing winter fuel. Tillage afforded straw to support a few cattle; and before spring, the neighbors frequently met to lift their cows, or to draw them out of the bogs, "into which they had been tempted by the first appearance of vegetation." The existing Scotch farmers are distinguished for genteel and comfortable living; and the laborers, in their well-furnished cottages, enjoy an elegance to which noblemen were formerly strangers.

Among the Greeks and Romans, spinning was the

chief employment of females; and the duties of a wife were symbolized by the distaff and fleece. Spinning, through successive inventions, is performed almost entirely by machinery. Warping was first performed upon pins, then upon a revolving frame, then upon a machine which stops when a single thread breaks. The Indians of South America, according to Ulloa, take up each thread by the hand, and spend three years in weaving a hammock. Muslins are manufactured in India in nearly the same manner as in the earliest ages. The weaver spreads his web under a tree, uses his toes for treadles and his shuttle for a batten. The steam-engine, the spinning-jenny, and the power-loom, have altered the face of civilization. The cloth manufactured in a single district of England by two hundred and seventy-two thousand hands, would, under the old system, have required sixty-seven million operatives, nearly three times more than the whole kingdom contains.

Fabrics previously worn only by the affluent, now compose the ordinary vestments. In England, thirty persons can afford to wear cotton, where one could thirty years ago. From the rapid improvement in the quality and quantity of woolens, a suit which was purchasable only by a gentleman, is now within the means of the humblest laborer. Three or four centuries ago, not one in five hundred could bear the expense of knit hose; now, since the introduction of machinery, so few are without them that a destitution indicates the abjectest poverty.

"To print a piece of calico by hand, the block must be applied four hundred and forty-eight times, for

each color." With a machine, "one man, with three children," can "turn off as much work as twenty men and twenty children in the ordinary block-printing." The piece rolls through the cylinder, and is printed in four or five minutes. Calicoes, seventy years ago, cost more than seven times as much as at the present day. The humbler classes have the means of neatness and gayety; and the cottage is provided with handsome furniture for beds, windows, and tables. An air of elegance is thrown over society, appearing in dress, habitations, and manners.

About the middle of the last century, the cylinder for comminuting rags was invented in Holland, and adopted in France, England, and America. The endless web preserves a uniform thickness, leaves no defective sheets, and works in any season. Printing ink was formerly put on by stuffed balls; afterwards, by a roller, which did the work with more exactness and rapidity. Thirty years ago, a number of the English Quarterly Review was printed in three months; now it is printed in twice as many days.

Printing has created much of the art and science which adorns and enriches civilized nations. This art which seems to defy the havoc of time and barbarism, has secured scientific and literary longevity. A small volume, such as can now be printed in a few hours, could not formerly be transcribed for less than twenty dollars. A sum which formerly purchased fifty volumes, now purchases a thousand. The copyist of ancient times, sometimes spent fifty years in transcribing a single Bible. Five hundred dollars were paid for a single manuscript concordance, and

the same price per volume for a copy of the works of Livy. The royal library of Paris, which, in the fourteenth century, contained nine hundred and nine volumes, then an extraordinary number, now contains more than four hundred thousand volumes.

In the infancy of society, materials were deposited in buildings by human strength. No sledges, carts, scaffolds, cranes, or machines, were used by the Mexicans and Peruvians. They broke stones with flints, polished them by friction, and constructed magnificent edifices. The labor expended in raising and fastening the stones of the great pyramid of Egypt, might be performed by thirty thousand men, using a steam engine, in a single day. Masses of stone are now separated by powder, conveyed on carriages, and raised into edifices almost without human intervention. An uncivilized country, with as many inhabitants as Britain, contains only ten thousand houses. Britain contains two hundred and fifty times that number, the poorest of which are more commodious than the finest among the barbarians.

Architectural styles descend by hereditary succession; and many ancient specimens, by violating philosophic principles, have been doomed to premature ruin. Strong cements, or iron clamps, were required to retain the stones in the Roman walls. The lower portions of a dome, if too vertical, are liable to separation. Moorish arches were liable to be pressed inwards. Gothic arches were unsuitable for sustaining lateral pressures, and groined vaults threw the pressure unequally along the walls.

To collect books and antiques, to found professor-

ships, to patronize men of learning, became almost universal passions in Florence. During this magnificent period of the fine arts, the revenue of the republic was a larger sum than the grand duke of Tuscany now derives from a much larger territory. The woolen manufactures, which employed two hundred factories and thirty thousand operatives, annually sold for twelve hundred thousand florins. Two banking houses, out of eighty which conducted the commercial operations, advanced to Edward the Third upwards of three hundred thousand marks. The city and its environs contained one hundred and seventy thousand inhabitants; and of the ten thousand children in the schools, six hundred received a learned education. Every place to which trade extended, from the Tigris to the Clyde, was ransacked for models and manuscripts. The villas, marts, ports, arsenals, museums, and libraries of the enlightened states of Italy, in the age of Lorenzo the Magnificent, were filled with plenty, comfort, and elegance. The Appenines were covered to their very summits with rich cultivation; and the Po, which wafted the harvest of Lombardy to the granaries of Venice, returned the silks of Bengal and the furs of Siberia to the palaces of Milan.

England has advanced under very heavy expenditures. Cæsar found a barbarous people clothed with skins, lodged in hovels, and sustained by a few herds. In the ninth century, Alcuin, an abbot with ten thousand vassals, preferred his smoky house to the palaces of Italy. In the fourteenth century, the town of Colchester, containing three hundred and ninety house-

keepers, with thirty different tradesmen, was assessed at little more than five hundred pounds. The carpenter's tools, consisting of two broad-axes, an adze, a square, and a spoke-shave, were estimated at one shilling. The mercer's stock, comprising "a piece of woolen cloth, some silk and fine linen, silk purses, gloves, girdles, leather purses, and needle work," was estimated at three pounds. The furniture of the most opulent, "was a bed, a brass pot, a brass cup, a grid-iron, and a towel."

In the fifteenth century, "there were very few chimneys, even in the capital towns." "The houses were wattled, and plastered over with clay; and all the furniture and utensils were of wood. The people slept on straw pallets, with a log of wood for a pillow." To keep out the winds, the nobility hung curtains against the walls; and "the country houses, instead of glass, did use much lattice, and that made either of wicker, or fine rifts of oak, in checkerwise." Rags, for making paper, were difficult to obtain; the clergy alone wore white linen; sumptuous garments descended from generation to generation; and the lord of the town "lay seldom on a bed of feathers." "Every thing nauseous" lay under the rushes; and "Becket was reputed extravagantly nice, because he had his parlor every day strewed with clean straw."

In the sixteenth century, the duke of Northumberland seems to have occupied three country seats, and to have had furniture only for one. "No mention is any where made of plate; but only of the hiring of pewter vessels. The servants seem all to have bought their own clothes from their wages." This family,

consisting of two hundred and twenty members besides invited guests, consumed sixty gallons of mustard, ninety-one dozen candles, eighty chaldrons of coals, and seventy ells of coarse linen, in a year. Only two cooks were employed, and only forty shillings expended for washing, and that principally upon the linen of the chapel. The establishment consumed very few vegetables, and, with the exception of a short time, lived upon salt meat during the whole year. No poultry was allowed, except for the duke's "own mess;" but no plovers were allowed even for that purpose, except at "Christmas and other principal feasts." Any servant who was absent a single day, had his mess struck off, and every ham or fish was required to be cut into the precise number of pieces.

According to Fortesque, the peasantry ate apples, brown bread, a little lard, or the entrails of beasts slain for nobles and merchants. The opulent, though they used meat, had very few delicacies. In the reign of Edward the Sixth, the students of Cambridge dined on pottage made of a farthing's worth of beef, with a little salt and oat meal. Harrison states that "the gentry commonly provide themselves sufficiently with wheat for their own tables;" but "their households and neighbors must content themselves with barley, peas, or oats." Though corn was in the market, the artificer could only obtain "horse corn," "tares, and lentiles."

In the reign of Elizabeth, the households of the gentry lived on rye or barley, with peas, or oats mixed with acorns. A maid of honor sometimes had roast beef; a peasant could only indulge in gruel. Only

the most opulent could afford a potato or a radish. The queen's wardrobe was collected from Europe and Asia; the clothing of the commonalty was coarse and comfortless. Though the houses of the gentry began to improve, the peasantry still lived in clay hovels. Servants lay on straw without sheets; and the pewter consisted only of dishes, pots, or a few other utensils.

Ninety years ago, half the people fed on rye, barley, or oats, with a little honey. Sixty years ago, a rich family in Cumberland only used a peck of wheat during the year; and, in the richest counties, barley bread was the common food of the smaller farmers and common laborers. Wheat bread is now almost universally eaten in the poorest districts; and the consumption of meat, butter, and cheese, has increased in nearly a double ratio to population. Wheat bread is afforded to the parish poor; and vegetables, now so common, were not formerly found on the most luxurious tables. Great Britain, though noted for prodigality, has so much unconsumed commodities, that a merchant proposed to purchase Palestine, where Solomon once reigned over a numerous and opulent people.

Only a century ago, the common people of Scotland were coarsely cloathed, meanly fed, and rudely lodged. The want of food was often so severely felt, that they bled their cattle for subsistence, and repaired to the shore for shell-fish. Their stone and mud-houses were thatched with fern, and filled with smoke and soot. To live on the refuse of the flock, to construct their own furniture, was the lot which awaited the peasantry. The farm-houses of the Lothians were

thronged by mendicants; and the opulent in Glasgow purchased a poor-beef to last them during the year.

The United States advanced with such rapid strides, that "nothing in the history of mankind is like their progress." A few years ago they were thrown out on "the shores of a desolate wilderness, three thousand miles from all civilized intercourse." A Connecticut farmer, only sixty years ago, subsisted on pork, beans, Indian corn, maple sugar, and corn-stalk molasses, with tea and wheat bread on extraordinary occasions. His family was clothed in coarse linen or woolen garments; and his utensils were a frying pan, an iron pot, wooden trenchers and cups. At the present day, wheat bread, fresh meat, sugar and coffee, and garden vegetables, are used throughout the year. His family is clothed with delicate fabrics, his cooking utensils are neat and commodious, his table is furnished with fine crockery or elegant porcelain, and his rooms are adorned with tasteful drapery and beautiful carpets.

Consumptions for mental illuminations, perform many wonderful cycles before their final extinction. The prodigies of art, which, when predicted in the closet, received only ridicule, are now committed to history. "Incredulity is disarmed of its weapons as the fiend of old was by the spell of the sorceress." Art has invented arms as formidable as the lance of Astolfo; buildings as sumptuous as the palace of Aladdin; fountains as wonderful as the golden waters of Parizade; and conveyances as rapid as the hippogryph of Reggiezo. Philosophy is producing effects such as superstition never ascribed to the incantations of Merlin.

Davy, the celebrated chemist, declared it to be just as possible to "cut a slice from the moon" as to light the streets of London with gas. Now, respectable towns and cities, though remote from coal fields, are adorned with this brilliant illumination. Only a few years ago, the learned Lardner asserted that no steam vessel could ever cross the Atlantic. Now, steamships are regularly passing, and triumphantly encountering frightful hurricanes and storms. "Francis Fortune, who predicted that a run from Bristol to London, would be made upon a rail in four hours, was shunned as a maniac." Now, that distance is traveled over in a little less than two hours. Nature has yet in reserve for man completer instruments, higher posts of observation, and an augmented number of observers prepared for brilliant conquests. The next fifty years may look back upon our age as possessing comparative imbecility.

Philosophy is always progressing, and only its first fruits are visible. "A point," says Macauley, "which yesterday was invisible, is its goal to day, and will be its starting post to morrow." Locomotives are improving in economy, speed, and safety; and guncotton, the consumption of which is constantly increasing, is already used to propel machinery. The telegraph already stretches several thousand miles, and seems destined to encircle the globe. "Magic wires," says Calhoun, "are stretching themselves in all directions over the earth, and when their mystic meshes shall have been united and perfected, our globe itself will become endowed with sensitiveness; so that whatever touches on any one point, will be instantly

felt on every other." Such consumption will be "one of the great means of ushering in the happy period foretold by inspired prophets and poets, when war shall be no more."

CHAPTER VII.

TASTE.

A DIVERSITY of taste prevents dreary sameness, and gives a rich variety to human pursuits. The mind is delighted in the chaste simplicity of Attic grace, in the wild luxuriance of Oriental pomp, or in the stupendous grandeur of Gothic magnificence. As desire can only be gratified to the extent of his labor, each person's taste is indicated by the commodities which he chooses to possess. Each, according to his peculiar fancy, delights in costly edifices, sculptures, and paintings, tasteful cemeteries, elegant furniture, delicate food, splendid equipage, personal ornaments, or literary embellishments. This variety, in its minutest shades, is included in the comprehensive induction.

I. The ancients erected strong fortifications, stately towers, beautiful temples, splendid palaces, and elegant mansions. This architecture was noted for immovable firmness, gigantic height, and prodigal splendor. The walls of Troy are celebrated in song and story as the work of supernatural beings; and Palenque, the ruins of which are twenty miles in circumference, was surrounded with stupendous walls and fortifications. The round tower of Rhode Island

is a mystery to the inhabitants; and the uses of the seven round towers of Ireland, are unknown in history. The monuments of Copan, standing in the depths of a tropical forest, are strange in design, rich in ornament, and excellent in sculpture. The large cities of India, as a characteristic feature, exhibit large domes, and high octagonal towers or spires. One monarch built a hunting palace, "fifty sluices, forty mosques, thirty-five hospitals, one hundred tombs, ten baths, ten spires, one hundred and fifty wells or fountains, one hundred bridges, and innumerable pleasure gardens." The Persians, for the celebration of their sacred rites, surrounded an open area with columns without architraves or roofs. Persepolis, Paestum, Babylon, Nineveh, Sidon, Tyre, Aradus, Sarepta, and Jerusalem, had magnificent architecture.

1. The wandering Tartars, who were attached to the soil by a frail tenure, suited their buildings to their nomadic habits. The humble tent, so suitable to their necessities, gave rise to a style of architecture which is still in use among their more opulent posterity. Chinese dwellings, as represented on their porcelain, exhibit the tent, which is advanced to the pavilion, as the most prominent feature. The concave roof resembles canvas, and the portico imitates the awnings before shops. The temples which are profusely scattered over the empire, are enriched with the most gorgeous ornaments. The architecture of the Arabians is richly ornamented with stucco and mosaic. The Turkish minaret is a tall slender tower of a peculiar style.

The tower of Nankin, an octagon of nine stories, is

covered on the outside with porcelain, the enameling of which appears like gold, emeralds, and rubies. A large gold pine-apple surmounts the pinnacle; and, at each story, is a gallery with green roofs and gilded pillars, from which suspended bells sound sweetly in the breeze. The temple of Honam is entered through an avenue of colossal statues. "Lacquered pillars, set in sockets of granite, support the fanciful eaves of the roof, which is decorated at the angles with dragons." "Pillars of gold and crimson, covered with inscriptions and ornaments," shoot up "to sustain the carved and painted ceiling;" and "lanterns of horn and glass, set in exquisite frames and hung by silken cords," depend "from the interlacing web of rafters."

2. The Egyptian style, originating in the mound, has massive walls sloping inwards, and is studded with columns decorated with various capitals. This colossal architecture, which seems destined for antiquities, looms up as expressive records of physical and intellectual strength in hoary antiquity. A pyramid, the capacity of which is six million feet, rises four hundred and sixty-four feet above the plain. The portals of the temple at Cnuphis, are sixty feet in height; and the columns of the portico of Hermopolis are thirty feet in circumference. The gateway to the temple of Luxor, is more than two hundred feet in length, and rises more than sixty feet above the sand. The temple of Carnac, which is twelve hundred feet long, is approached through twelve rows of sphynxes. Columns fifty feet in height stand in the court in front; then a portico of one hundred and thirty columns, averaging twenty-eight feet in diame-

ter. The walls are covered with sculptures which illustrate the uses of the sanctuary, and the ceiling is studded with stars on a blue ground. Other edifices, connected with the grand temple by colonnades and porticoes, form the Carnatic ruins. In the large temple of Dendera, the sculptures are necessary to the grand design. A large cornice contains the head of Isis, and a large torus encircles the whole building. The head of Isis, and occasionally the globe and wings, form the capitals. The interior is splendidly decorated with illustrations of religion, astronomy, and social life.

The architecture of the ancient Hindoos at Elephanta, Ellora, and Salsette, exhibit the Egyptian character, consisting of temples carved out of solid rocks. Subterranean chapels contain colossal statues sculptured on the walls, representing Hindoo deities and fabulous history. Seven temples among the ruins of a city, are excavated in solid rock, with sculptures representing animals. One consists of a solid pyramid upon a double terrace; and the gallery on the top has a gilt umbrella, fifty-six feet in circumference. Petra, a city of the Arabian desert, has excavated temples, palaces, and tombs. Architecture, excavated in subterranean rocks, is found in Mexico and Japan. The columns of the ancient mosque of Decca, of a light and airy appearance, resemble the style of excavated temples.

The architecture of the Moors is distinguished for numerous arches and flowery decorations. The Alhambra, a correct type of the most gorgeous oriental palaces, appears more like fairy than human archi-

tecture. A court, in the centre of which is a deep marble basin, is surrounded by an arcade with marble and mosaic incrustations. The walls and ceilings are covered with beautiful festoons, sculptures richly gilt, and painted arabesque. The court, in which twelve lions support an immense basin, is surrounded by a colonnade of white marble, and paved with colored tiles. The light pillars are grouped, and the walls and ceilings are covered with gold, stucco, and brilliant colors. In the hall of Abencaroges, receding ornaments are illuminated in gradations with leaf gold, pink, light blue, and dusky purple.

3. Grecian buildings, which are improvements of wooden cabins, furnish models for modern architecture. These originally rude edifices gave rise to the orders of architecture, or the proportioning and decorating the column and its architrave. Each of the orders is named after the country in which it arose. The Doric possesses a masculine dignity; the Ionic exhibits a feminine gracefulness; and the Corinthian displays a profuse and delicate elegance. As the richness of the Corinthian capitals rendered them too expensive of general adoption, the ancients employed them in buildings in which elegance, gayety, and magnificence, were required; such as temples dedicated to Venus, Flora, Proserpine, and the river and fountain nymphs.

The most perfect specimen of the Doric, is the Parthenon; and the most beautiful specimens of the Ionic, are the temple on the Ilissis, and the temples of Neptune and Minerva on the Acropolis. The finest specimens of the Corinthian, are the monument

of Lysicrates in Greece, and the three columns of the Campo Vacino in Rome. The temples of Athens, Corinth, and Paestum, were magnificent edifices; and the temple of Ephesus, so highly celebrated, was respected by successive dynasties. The sepulchral monument of Mausolus was surrounded by thirty-six columns, and the pyramid over it was surmounted by a chariot drawn by four horses. The vast expense of this monument caused Anaxagoras to exclaim: "How much money changed into stones." The palaces of Egypt, the fanes of Syria, and the temples of Idumea, were adorned with Grecian architecture.

4. Gothic architecture is modeled from groves under which the Druids performed their sacred rites. It consists of large buttresses, clustered pillars, profuse ornaments, pointed arches, pinnacles, and spires. The splendid Gothic edifices of Europe, springing into being from the necessities and convenience of the splendid ritual of the church, have ornaments entirely at variance with classic taste. The Gothic style, at first employed in sacred architecture, was afterwards introduced into palaces.

The cathedral of Fryburg has arched windows; roses in a vast labyrinth of intertwisted ramifications; balusters interwoven with contortions, and surmounted by ornamental pinnacles; elegant niches with figures surmounted by canopies; pillars with capitals of varied foliage; flying buttresses and angles adorned with flowers and buds; a staircase winding up by numberless slender pillars; rain-spouts in figures of men, animals, and allegoric personages. The cathedral of Milan, with a front of Grecian and Gothic

styles incorporated, exhibits a multitude of corridors, platforms, parapets, flying buttresses; a forest of spires; needles, covered with ornaments, shooting out over its ample roof.

After the Norman invasion, the taste of Britain began to show itself in devising the Gothic. Circular and pointed arches were sometimes intermingled, and the windows were divided into several lights by mullions branching out at the top into various forms of tracery. Ornament after ornament was added, till spires, decorated to the very pinnacle, shot up into the clouds, and windows of stained glass shed gorgeous lights over the profuse interior decorations. Westminster Abbey "appears as if the artist had intended to give to stone the character of embroidery, and to enclose the walls within the meshes of lace-work." It is sprigged, fretted, turreted, vaulted, and divided into chapels.

The Romans reared mountains of masonry within their capital, for their theatre, amphitheatre, and circus. The Pantheon, which extended a marble firmament overhead, had walls nineteen feet in thickness, with niches for chapels, altars, and statues. It was encrusted inside with marble, and covered outside with brazen, silver, and gilded plates. The capitol, one of the largest and grandest structures, was adorned with costly gilding. Buildings of great splendor were devoted to legislative and judicial purposes, to the celebration of religious rites. Large buildings were designed for dramatic exhibitions, naval engagements, and gladiatorial shows. One of the buildings sacred to the nymphs, con-

tained artificial water-falls, and statues of those imaginary beings. Porticoes, one of which contained a thousand columns, were adorned with statues, and designed for public promenades. Rome, at one time, contained more than one hundred palaces belonging to private persons, each of which occupied more space than a hundred ordinary houses.

The theatre of Marcus Scaurus, which was embellished with three hundred and sixty marble columns, was capable of holding eighty thousand spectators. The amphitheatre of Titus, celebrated for its awful grandeur, was an elliptical building "five hundred and sixty-four feet in length, and four hundred and sixty-seven in breadth, founded on fourscore arches, and rising with four successive orders of architecture to the height of one hundred and forty feet. The outside of the edifice was encrusted with marble, and decorated with statues." The vast concave contained eighty rows of marble seats covered with cushions, for accommodating eighty thousand spectators. Sixty-four vomitories poured forth the immense multitude; "and the entrances, passages, and staircases," "were so contrived that each person arrived at his destined place without trouble and confusion." The spectators "were protected from the sun and rain by an ample canopy, occasionally drawn over their heads. The air was continually refreshed by the playing of fountains," which were profusely scented with grateful aromatics. The stage "successively assumed the most different forms. At one moment it seemed to rise out of the earth, like the garden of the Hesperides, and was afterwards broken into rocks and cav-

erns of Thrace." The subterranean pipes could suddenly convert a level plain "into a wide lake, covered with armed vessels, and replenished with the monsters of the deep."

"The baths stood among extensive gardens and walks, and often were surrounded with a portico. The main building contained halls for swimming and bathing," for conversation and athletic exercises, for declamation and lectures, for every "polite and manly amusement." The arts "exhausted their refinements on these establishments, which, for their extent, were compared to cities." "The baths of Caracalla were ornamented with two hundred pillars, and furnished with sixteen hundred marble seats." "Those of Diocletian, surpassing all the others in size and sumptuousness of decoration," "were enriched with the precious collection of the Ulpian library." "Of the private baths, the walls were of Alexandrian marble, the veins of which were so disposed as to resemble a regular picture; the basins were set round with a most valuable kind of stone imported from the Grecian islands; the water was conveyed through silver pipes, and fell by several descents in beautiful cascades; the floors were inlaid with precious gems; and an intermixture of statues and colonnades, contributed to throw an air of elegance over the whole."

Their triumphal arches were supported by splendid columns, and covered with historical sculptures. The column of Trajan consists of thirty-three pieces of white marble, secured by clamps of bronze. It is ascended inside by a spiral staircase, which is lighted by forty-three apertures. The series of sculptures

runs around the pillar in an ascending spiral riband, making twenty-two revolutions, and representing the successive victories of Trajan, among which are two triumphal processions. The figures, which are represented with great spirit, are three thousand in number. "A square obelisk of brass" was erected at Constantinople. It "was embossed with picturesque and rural scenes; such as birds singing; rustics laboring, or playing on their pipes; sheep bleating; lambs skipping; the sea, and a scene of fishing; little cupids laughing, and pelting each other with apples; and on the summit, a female figure turning with the slightest breath, and thence denoted the wind's attendant."

The villas of the Roman emperors and consuls possessed a singular magnificence. Hadrian's villa at Tivoli, which was nearly ten miles in circuit, was composed of temples, baths, a theatre, and magnificent houses for lodging friends, servants, and soldiers. The Atheneum, Lyceum, Academy, Pœcile, and other Grecian buildings, were imitated with very little variation. The grounds around the villa were laid out to imitate the ideal Elysian fields.

Some of the Roman aqueducts were more than sixty miles long, carried through rocks and over mountains, supported on arches sometimes one hundred feet in height. Rivers were spanned, lakes drained, light-houses erected, and the sea enclosed "within the cincture of masonry." Eight bridges across the Tiber are enumerated by Victor, and splendid remains of bridges are found in Italy, Portugal, and Spain. Thirty-one great roads, built of substantial materials,

traversed Italy, and terminated only with the frontiers of the empire. "Mountains were perforated, and bold arches thrown over the broadest and most rapid streams."

In contrariety to Grecian simplicity, the Romans used the most profuse and fantastic ornaments. They disfigured "their spoliations from the Greeks" "with carvings, dentils, dentricals, drops, and festoons." They added the Tuscan order; and the composite order, a combination of the Ionic and Corinthian, was employed in their triumphal arches. Their buildings possessed splendor, vastness of conception, and prodigality of expenditure. The cities of Italy were adorned with ancient fragments of Grecian details, sometimes piled into incongruous structures, sometimes into imposing edifices. The cathedral of Rome, which was more than a century in its completion, was converted from complexity into elegant simplicity. A spacious piazzo and covered galleries, wing out from the sides; and the semicircular porticoes which start from these galleries, sweep round the open piazzo with indescribable grandeur. The porticoes are supported by four rows of Doric columns, forming a central arcade. Two hundred and eighty columns are surmounted with a balustrade, on which stands one hundred and ninety-two colossal statues.

Asiatic cities were decorated with Grecian beauty and Roman magnificence. Some of the excavated temples of Petra exhibit the Corinthian column; and the Saxons formed their style from the specimens left by the Romans in Britain. British architects were employed to rebuild Autun, in Gaul; and

Ambrosius, a British commander, built a splendid palace at Canterbury. The remains of many castles and abbeys exhibit rude representations of the Roman style, and clumsy imitations of the Tuscan, Ionic, and composite orders. The castellated entrance towers, being composed of dark blue limestone, have massive and gigantic features.

The Greeks, at the expense of domestic convenience, devoted vast treasure to temples and other public buildings. Marble tiles were terminated by ornamental frontons, alternating with the lions' heads over the cornice. Tiles, with a raised border, had tiles to cover the juncture, and to form a compact frame-work. The water descended through channels, and discharged itself through openings in the lions' heads. The frontons were either painted or sculptured, so as to represent leaves, aplustria, or masks. Pliny mentions tiles which overlapped like the feathers in a peacock's train. Tiles of bronze and gilt constituted a still more expensive and magnificent roof. Athens, in the time of her proudest glory, suffered her citizens to wade a stream for want of a bridge.

The Colchians erected houses of logs, filling the interstices with chips, moss, and clay. The Gauls, to the time of Vitruvius, made walls of dried lumps of clay. The Romans originally made walls of canes and hurdles covered with clay. Their stone walls were diversified by panels; and their decorative painting imitated marble slabs, or various architectural decorations. Their long galleries and corridors, were painted with various kinds of landscapes, or even

subjects from the poets and the higher walks of history.

The private houses of Attica became elegant, having painted walls and ceilings, mosaic or colored stone floors. They usually stood within beautiful enclosures, and the doors usually had inscriptions. A narrow passage led into the court, which was surrounded on all sides by porticoes. Around this court were dormitories, store rooms, chambers, parlors, libraries, picture galleries, banqueting rooms, and apartments for attendants, musicians, and actors. Warmth was produced by fire-places, portable stoves, or chafing dishes.

In the latter ages of the republic, the Romans erected spacious mansions adorned with columns, paintings, and statues. Thresholds were adorned with Numidian marble, and rooms were lined with marble slabs. Private houses, in the time of Augustus, had marble encrustations, mosaic floors, and decorations in ivory, marble, costly wood and precious stones, attached to the walls, ceilings, and door-posts. The hearth, which retained its position after refinement had provided a kitchen and dining room, was decorated on festive occasions with garlands or fillets. The houses of Pompeii were numbered, the windows glazed, and the rooms adorned with elegant and whimsical lamps.

The walls of small gardens in towns were painted in imitation of a rural garden, with the small area ornamented with flowers in elegant vases. The Greeks cultivated flowers for garlands; and Plutarch speaks of setting off the beauty of roses and violets, by planting them side by side with leeks and

onions. The horticulture under the Ptolemies was, according to Longus, "roses, lilies, hyacinths, and violets;" and the principal flowers of the Romans seem to have been violets and roses, with crocus, narcissus, lily, gladiolus, iris, poppy, and amaranth. Mention is made of houses for preserving foreign plants, producing flowers out of season, and forcing grapes and melons. The sloping sides of raised terraces, were planted with evergreens or creepers, and trees and buildings covered with ivy. Their gardens were adorned with large trees, fruit trees, clipped evergreens, acanthus beds, vines, pyramids, statues, and fountains.

II. The taste of ancient nations is displayed in their statuary, paintings, mosaics, and engravings.

1. The statuary of the Egyptians, like their architecture, was executed in the colossal style. Their sculpture was attended with nicety in the minutest parts; and statues standing on the pinnacles of temples, were finished as if designed for the closest inspection. The sphinx represents an animal with a woman's head, a lion's body, and an eagle's wings. The largest sphinx, situated near the great pyramid, is sculptured out of solid granite, with a temple between its paws, and a tablet covered with hieroglyphics on its breast. For the distance of two miles among the ruins of Thebes, the road lies between two rows of colossal statues; and two of them with mitred head-dresses, though bedded in sand, are twenty feet above the surface. The Hindoos placed colossal statues at the entrance of their temples.

A bronze statue, ninety feet in height, was erected

at Rhodes; and, according to Pausanias, statues of thirty feet and upwards were not uncommon in Greece. Phidias was constantly employed in executing statuary, and his greatest work was a colossal statue of Jupiter at Olympia. Artists, in the reign of Alexander, studied to please the beholder with beauty and simplicity, not to astonish him with grandeur and majesty. Praxitiles executed two Venuses, and many persons made voyages to see the one which was purchased by the Cnidians. Lycippus, according to Pliny, executed six hundred sculptures; and his celebrated bronze horses successively adorned Corinth, Rome, Constantinople, Venice, and Paris. Statues adorned the Grecian temples, hills, groves, fountains, public squares, private dwellings, country seats, sequestered walks, and ornamental gardens.

Several colossal statues were conveyed from Greece to Rome by Lucullus and Fabius Maximus. A statue of Jupiter upon the capital, was so large as to be seen from the Alban Mount. A bronze statue of Apollo was erected in the Palatine Library; a bronze statue of Augustus, in the forum. An equestrian statue of Domitian was made of gilt bronze, and a marble colossus of Nero was one hundred and twenty feet in stature. The splendid group of Laocoon, found in the baths of Titus, consists of the father and his two sons, writhing in the coil of two huge serpents. The expression of extreme agony in the features, the struggle to break the deadly grasp, the cry of distress indicated by the mouth, the entreating look of the sons, are among the most striking traits. The group of Niobe and her children, consisting of fifteen figures,

has a lofty style, uncommon elevation, tragic expression, and a great variety in the combinations. The largest of the ancient groups consists of a bull, two youths larger than life, and three small figures.

An ancient statue, an ideal of youthful beauty, represents Apollo just after discharging his arrow at the serpent Python, and indicates a noble satisfaction in the assurance of victory. The equestrian statue of Marcus Aurelius, seems to move forward; Antinous has his head crowned with a garland of lotus flowers; and Flora has a feminine expression, with the most elegant drapery. The statue of Aristides, a figure "as near perfection" as art can achieve, "stands with his arms folded in his cloak, in all the dignity and integrity of his character." Wilber Fisk desired that "such a dignified personification of integrity," could be exhibited "to the youth of America," "to aid in elevating their characters, and strengthening their principles."

The sphinx, the river horse, the crocodile, the victorious charioteers, and the wolf suckling Romulus and Remus, with other statuary, adorned Constantinople. An ass with his driver, erected by Augustus at Nicopolis, was conveyed to the new capital. An eagle holding a serpent in its talons, was a monument to Apollonius who delivered Byzantium from venomous reptiles. An equestrian statue represented Joshua stretching out his hand to stop the sun; and the figures of Belerophon and Pegassus, seemed hardly to touch the ground. The Phrygian shepherd was represented in the act of presenting to Venus the prize of beauty, the apple of discord. Helen was

delineated "with well-turned feet, snowy arms, rosy lips, bewitching smiles, swimming eyes, arched eyebrows, flowing hair," and harmonious figure. The manly form of Hercules seemed to be restored to life; "his chest ample, his shoulders broad, his limbs muscular, his hair curled, his aspect commanding." The hero, with "his lion's skin carelessly thrown around him, was seated on an osier basket, his right leg and arm stretched to the utmost, his left knee bent and supporting his elbow, his countenance indignant and pensive." A colossal statue of Juno, which once adorned her temple at Samos, was in the attitude of being drawn by four yoke of oxen to her palace. A statue of Minerva, thirty feet in height, represented with spirit the attitudes and character of the martial maid.

2. Venus Anadymene of Apelles, purchased by Augustus for one hundred talents, was esteemed, from its gracefulness of expression, symmetry of form, and delicacy of finish, the most faultless performance executed by the Grecian pencil. The works of Aristides were in such high repute, that the king of Pergamus gave a hundred talents for only one of his pictures; that the tyrant of Elatea paid him for a battle of the Persians, in which were a hundred figures, at the rate of ten minæ for each figure. Mnason gave Asclepiodorus three hundred minæ each for twelve pictures; and Aratus, who sent some old pictures to the king of Egypt, was presented with one hundred and fifty talents in return. Ptolemy Soter employed agents in Greece to purchase celebrated paintings; and Athenæus mentions the pictures of Sicyonian masters, which

contributed to the display of the celebrated festival of Ptolemy Philadelphus at Alexandria.

Plutarch, in his description of the triumph of Emilius, says that the paintings and statues brought by him from Greece, required two hundred and fifty wagons to carry them in procession, and that the spectacle lasted the entire day. Marcellus and Fabius Maximus carried to Rome no more works of art than they deemed necessary to adorn their triumphs, or to decorate some public buildings. These spoliations of Greece and of the Grecian kingdoms, continued for about two centuries; yet, according to Mucianus, Rhodes alone contained more than three thousand statues. Mummius, after the conquest of Corinth, deported or destroyed more works of art than all his predecessors put together. Scaurus transported all the public pictures remaining in Sicyon to Rome, and adorned his great temporary theatre with three thousand statues. Verres ransacked Asia and Achaia, and took twenty-seven beautiful pictures from a temple at Syracuse.

After Marcellus had displayed the Grecian arts, and Mummius had transported the spoils of Achaia to Rome, a taste for the fine arts grew into a passion. Besides adorning temples and public buildings, private collections were made, and, towards the close of the Republic, the houses of the rich had a room devoted to paintings and statues. Vitruvius, in the time of Augustus, includes the picture gallery among the ordinary apartments of a complete mansion.

3. In the apartments of a ship, the whole fable of the Iliad was represented in mosaic. Of the many

extant mosaics, one represents four doves around the rim of a vase; another, a school of philosophers, and the history of Hesione, the daughter of Priam. One represents the battle of Issus; another, an Egyptian festival. One contains a representation of a bird so small as not to be distinctly visible without a magnifying glass; another contains, in the third of a superficial inch, a duck in form and coloring equaling a miniature painting. One represents the games of the circus, and the portraits of the muses interspersed with real and imaginary figures; another, a master of the chorus instructing his actors, the masks for distribution, a female playing on a flute, the Ionic columns of a portico, garlands hanging in rich festoons, a gallery tastefully decorated with figures and vases.

4. Astronomical calculations, according to Josephus, were engraved upon pillars; and hieroglyphics constitute a part of the Egyptian temples, walls, and pyramids. The walls of Babylon, according to ancient historians, were covered with hieroglyphics; and, according to Diodorus, two pillars erected by Semiramis portrayed "all sorts of living creatures, with great art and in curious colors." Jerusalem, "in her youth," says Ezekiel, "saw men portrayed upon a wall" in vermilion. The ten commandments were written on stone; the poems of Orpheus and Hesiod were cut in lead; and Job desires that his "words were graven with a pen and lead in the rock." In many sections of Oregon, the rocks contain inscriptions which the natives hold in the highest reverence. Engravings upon rocks are found in the desert of Idumea; and a rock in Massachusetts seems to record a battle be-

tween the natives and some foreigners who came to the shore in ships.

Moses was commanded "to make a plate of pure gold and grave upon it, like the engraving of a signet." Seal rings were worn in the time of Joseph, the rudest being engraved upon jasper. Theodore of Samos engraved a lyre upon a famous emerald belonging to Polycrates; and Pamphilius, a pupil of Praxiteles, engraved upon an emerald a representation of Achilles playing upon a lyre. Scipio Africanus sealed with a sardonyx, it being almost the only gem "which left a fair impression, and brought away with it no portion of the wax." The names of six tribes of Israel were engraved upon an onyx; the name of one tribe upon each of twelve precious stones.

Gems, being in good preservation, exhibit by the air of the etching and the nature of the polish, the ancient taste and genius. The figures preserve the memory of particular persons, remarkable events, religious rites, and civil customs. Some gems contain figures single or grouped, with various costumes and appendages, illustrating history, hunting, festivals, and sacrifices; or arbitrary devices, exhibiting mythologic, allegoric, and imaginary objects. Alexander's head appears upon a sardonyx; Medusa's head upon a chalcedony; the head of Socrates upon a carnelian; Bacchus and Ariadne upon a red jasper; an Athenian feast upon a carnelian. A sardonyx, called the agate of Tiberius, exhibits the apotheosis of Augustus, the captives of various nations, and the investiture of a priestess in the family of Tiberius. One gem represents Tiberius descending from his chariot; an-

other, Claudius and his family drawn by centaurs; another, Jupiter in his chariot hurling thunderbolts as he is driving over the prostrate Titans.

Homer ascribes heraldic engravings to the Phenician artists. The ornaments of Helen were richly engraved; and on one golden clasp of Ulysses, was engraved a representation of the dolphin which saved the life of Telemachus; on another, a hound in full chase after a fawn. The Greeks, who possessed the alphabet, never used hieroglyphics, and engraved signets and armor with emblematic devices. Painted vases, urns of stone, and shallow dishes of brass, are found engraved with some mythologic device in a few bold lines.

Engraving, to a limited extent, was cultivated among the Celtic and Gothic nations. At Athelney, where King Alfred was an exile, was found a jewel of filagree work, on which is engraved the head of Hubert and a profusion of foliage. In the old English sepulchral monuments are found devices engraved upon brass, exhibiting a greatly improved state of the art. In the interior of a Mexican pyramid is a plane covered with picture writing, containing a history of Mexico, a tribute roll of each vanquished chief, and a code of their domestic, political, and military institutions. In the mounds of the valleys of the Ohio and Mississippi, are found many engravings. Through the long series of years, it did not occur to men to multiply impressions on parchment or papyrus.

III. To preserve the dead body from dissolution, the Egyptians put it through complicated operations, ornamented it with gildings and glass beads, and laid it

in a coffin adorned with emblematic paintings. Among the Gauches, the body was covered with aromatic varnish, enveloped in goatskins, enclosed in a case, and deposited in the catacombs. Mummies are found in Mexico, Palermo, Bremin, and other places; and the dead bodies of the Incas were carefully preserved by the Peruvians.

Sepulture was regarded by the Greeks as a most sacred duty; for without it they supposed that the deceased could not enter the Elysian fields. They placed an obolus in the mouth, crowned the head with flowers, and dressed the body in a handsome robe. Ordinary citizens of Rome were dressed in white togas; magistrates, in their official vestments. Their funereal couches were made of ivory, and covered with gold and purple. Cremation was practiced by the Romans as well as by the Greeks. The bustum in the centre of the Campus Martius, was surrounded by an iron railing, and planted inside with poplars. The relics of the body were placed in earthern, silver or gold urns.

The Christians committed the body to the earth as a seed which should decay, and spring up in "immortal bloom." The graves were adorned "with flowers and redolent plants, just emblems of the life of man, which has been compared to those fading beauties whose roots, buried in dishonor, rise again in glory." "The decaying flowers were afterwards supplanted by holly, rosemary, and other evergreens, which overshadowed the tombstones. The white rose was planted at the grave of a virgin, and her chaplet tied with white ribands in token of her spotless innocence, and black

intermingled to bespeak the grief of the survivors." The custom of ornamenting the grave with flowers, was "the spontaneous tributes of unlettered affection, originating long before art had tasked itself to modulate sorrow into song, or story it on the monument."

The ancients selected the resting places of the dead in the vicinity of cities, in the fields and woods, in the excavations of mountains, and by the side of their principal roads. The catacombs of Thebes were formed in the passes or glens of their thickly-wooded hills on the banks of the Nile; and those of Memphis, situated beyond the lake Acherusia, were called by the Greeks the Elysian fields. A portion of the Academic grove was devoted to sepulture, and laid out into spacious walks, ornamented with trees and flowers. The Romans buried their dead in the secluded recesses of the forests and valleys, and by the side of the Appian way. The aboriginal Germans had woods which were dedicated to the dead; and the rich Israelites placed their tombs on the mountains and in the valleys. The natives of Asia Minor buried their dead in the vicinity of their cities, and erected carved sarcophagi and magnificent mausoleums. In Turkey, some plain in the suburbs of cities is devoted to sepulture; and the relatives of the departed place at the head and foot of the grave a cypress tree. The spot becomes a lovely and sequestered grove, which is held inviolate under every social and political revolution.

Among the temples and tombs of Egypt, no trace of a dwelling is to be seen. The habitations of the living were regarded as brief resting places; the temples and tombs as eternal monuments and mansions. The

cemeteries of each city embraced a common depository, as well as separate tombs for nobler families. The sepulchral chambers were built of granite fitted up in costly magnificence, and richly ornamented with paintings. The tombs of the Theban Kings in the Lybian mountains, have a room so ornamented with sculptures and paintings as to be called "the hall of beauty." The sides of all the chambers and corridors are covered with sculptures and paintings; and in the large saloon was a sarcophagus of the finest alabaster, minutely sculptured, with several hundred figures which represent priests, religious processions and sacrifices, boats, agricultural scenes, and the most prominent events in the monarch's life. "A sudden transition," says Belzoni, "from the dreary desert to these magnificent tombs," operates "like a scene of enchantment." The labyrinth of Egypt, a large and complicated cavern with numerous passages, formed a series of palaces connected by winding avenues. The halls were surrounded with magnificent pillars; and the roofs and walls were encrusted with marble and adorned with sculptured figures. It contained, according to Herodotus, three thousand chambers, and the lower series afforded tombs for the monarchs.

Grecian tombs were preserved by the family, who, on certain days, crowned them with garlands. The sculptures seldom exhibited death in a direct manner; the head of a horse, signifying departure, was a very common representation. Sepulchral chambers found near Rome, have niches for depositing the cinerary urns, which contain inscriptions with emblematic devices. The tombs of rich marble were enclosed by

walls or iron rails, and planted round with trees. The subterranean tombs of Etruria, contain rooms and corridors branching out in various directions. The walls are coated with stucco, and ornamented with civic, heroic, and mythologic devices. The monuments of Christian sepulture, by their inscriptions and devices, recall the most interesting associations.

IV. The opulent classes of Egypt furnished their habitations with elegant tables, ottomans, couches, and chairs. The Greeks adorned their wooden tables with carvings and metallic plates. They reclined upon couches covered with tapestry, fitted up with pillows, and highly ornamented with ivory and precious metals. They made their bedsteads of solid maple, box-wood, or ivory, veneered with elegant wood or tortoise-shell. Their bed was stuffed with wool, feathers, or swan's down, and covered with sheets, blankets, or elegant carpets. The tables of the Romans were made of wood, which displayed the greatest variety of elegant spots, beautiful waves, and curling veins. Marble tables and folding tripods were very common; and the legs were made of carved ivory, white marble, or red porphyry. Their couches, the frames of which were made of wood, ivory, or metal veneered with tortoise-shell, were stuffed with swan's down, and covered with richly embroidered cloth. Their chairs had various forms, and distinguished persons were carried on sedans. After the importation of the soft luxuries of Asia, they made their beds with surpassing richness and magnificence. Their costly bedsteads were ascended by steps, their pillows were covered with

splendid casings, and their purple counterpanes were embroidered with gold in the most elegant figures.

The tapestry of Babylon, even as early as the days of Joshua, appears to have excited universal admiration. Publius Syrus compares a figured Babylonicum to a peacock's train; Martial celebrates the magnificence of the Babylonish textures; Pliny mentions the enormous prices paid for them to decorate dining-rooms; and Plutarch speaks of a splendid shawl which was bequeathed to the elder Cato. Carpets, manufactured at Babylon, Tyre, Sidon, Sardis, Miletus, Alexandria, Carthage, or Corinth, were spread upon floors, hung over doors, or put up as awnings or curtains. The finest carpets, sometimes representing hunting scenes, were spread upon sofas and thrones. A Persian palace, according to Gibbon, "was decorated with a carpet of silk, sixty cubits in length, and as many in breadth. A garden was depictured on the ground; the flowers, fruits, and shrubs, were imitated by the figures of the gold and embroidery, and colors of the precious stones; and the ample square was enriched by a variegated and verdant border."

The fishermen of Egypt formed their nets into a tent; and a gauze curtain was expanded over Roman beds and couches, to keep out flying insects. Curtains were used for partitions, concealing statues, and decorating the scenes in theatres. Napkins, which were used for wiping the fingers, were embroidered, or interwoven with gold. In the time of the emperors, the Romans began to cover their tables with linen cloths, some of which were striped with

gold and purple. Damask table-cloths were very ancient, and could be drawn up after meals to preserve the crumbs. Table-linen was so rare in England in the fourteenth century, that each table-cloth made for the nobility and gentry, cost thirteen pounds

Mirrors had a handle for convenience at the toilet; and those made of a mixture of copper and tin, were usually accompanied with a sponge and pounded pumice stone. Glass mirrors, though manufactured at Sidon in the time of Pliny, seem not to have come into general use. The obsidian stone was suitable for mirrors, but Nero had a mirror made of an emerald. The chamber of Venus, in Claudian's description, was covered with mirrors so that she could see her image in every direction. Domitian had a gallery lined with mirrors, which showed every thing which was going on behind his back.

The Romans had stoves for mulling wines, and moulds for making pies. They used strainers of broom, rushes, linen, or bronze, with perforations forming an elegant pattern. Their vessels for cooling wine were adapted to the purpose; and utensils called "self-boiling," are spoken of by Cicero as among the most costly Corinthian and Delian vessels. A large flat ladle with holes, was used for taking vegetables out of the pot, or for dispelling the froth from the surface. Wine bottles were covered with leather, and basins and pots had lids with beautiful ornaments. Drinking horns were adorned with the heads of birds or beasts; silver bowls, with ivy leaves, or inserted mirrors. Nero gave three hundred talents for a

cup; and mention is made of a cup cut out of a single agate, and richly engraved with numerous representations. Small plates and large dishes were used at the table for containing bread, meat, and fruit. An amber dish represented the countenance and history of Alexander; and a plate of white marble, not more than a quarter of an inch in thickness, was sculptured with a female figure, a floating scarf, and an ivy wreath. The castors, made of materials according to the circumstances of the possessor, were adorned with elegant figures.

The Spartans refused to indulge in metallic vessels, and the Persians condemned persons to drink out of fictile vessels as a punishment. The Athenians excelled in fine pottery; and the Tuscans, though less tasteful than the Athenians, executed clay statuary, with which the Romans adorned their most celebrated temples. The Romans resorted to Samos for their necessary articles, and, after their possession of metallic vessels, looked upon pottery with veneration. Murrhine vases came from Parthia, and Pliny speaks of a trulla which cost three hundred talents. Vessels for mixing wine were somtimes supported by colossal statues, and adorned with projecting griffons. The Warwick vase, a production of Lysippus, is made of sculptured glass, adorned with elegant figures in high relief. "Vines, leaves, tendrils, fruits, and stems," form "the rim and handles." It holds two hundred gallons, and in size, form, and beauty, is the most remarkable vessel handed down from antiquity. The Portland vase is a deep blue, semi-transparent urn, with opaque white ornaments, cut by the lapidary on

colored grounds. It has two curiously wrought handles, with sculptures in the greatest perfection. The figures are full of grace and expression, every stroke as fine, sharp, and perfect as any drawn by a pencil.

The discovery of Herculaneum and Pompeii, introduces the moderns to the Roman taste and customs. Among the elaborations, are mosaics, decorated pavements, elegant shells, statues, candelabras, lamps, vases, calefactors, tripods, beds, chairs, shields, kettles, saucepans, gridirons, ladles, spoons, bowls, and irons, mirrors, inkstands, weights, steelyards, dice, almonds, chestnuts, walnuts, pill-boxes, surgical instruments, combs, toothpicks, curling-irons, and pots of rouge with delicate brushes.

"The Roman knight," says an elegant writer, "at morning threw off his coverlet wrought with needle work at Babylon, and raised the tapestry of Tyre which hung before the entrance of his chamber. He entered his bath-room, the walls of which glistened with the marble of Alexandria, beautifully adorned with Numidian carvings. He ascended to his dining-room, furnished with Grecian statuary and pictures, and sank upon his Persian couch." "He wrote his letters upon paper from the land of the Ptolemies, and read from parchment manufactured at Pergamos. He anointed himself with the perfumes of Arabia the Happy. The iron of Spain served him for weapons. His dice were made from the ivory of India. He won his races with the horses of Epirus. Around the neck of his wife hung pearls from the German Ocean. His funeral litter was borne by slaves from beyond the Mediterranean, his lifeless remains turned to dust

in a tomb of porphyry quarried in the island of the Ægean."

V. After necessity ceases, the diversity of food arises from a diversity in taste, which is much modified by climate, custom and religion. The refreshing fruits of the torrid zone are grateful aliments to the native inhabitants, and the natural food of the polar regions is eaten with as high a relish as the choicest dainties in temperate climates. Food is too often injured by hurtful variety, and pernicious seasonings. Blood, which was so grateful to the Egyptians, was abhorrent to the Jew.

Attica imported corn from Syria, Egypt, Libya, Cyprus, Rhodes, Sicily, Eubœa, Cimmerian Bosphorus, and Thracian Chersonese. "Far, a grain similar to wheat, was, according to Martyn, the corn of the Italians." Alica, so highly esteemed by the Romans, was brought from Pisa, Verona, and Egypt. The flour of the best alica from Campania, was whitened with chalk from Naples. The bread of the Athenians was generally made at home, but it was also sold in the market by females. The bakers in Rome, like persons of other trades, formed a college. Shops were kept for selling wine, confections, fruits, and provisions.

Garlic was a favorite article among the Egyptians and Athenians; and, though banished from the tables of the fashionable in Rome, it was highly esteemed by reapers, soldiers, and sailors. The onion, so extensively cultivated in Egypt, was forbidden to the sacerdotal order. The bean, which was made into

bread by the ancients, was highly esteemed by the Romans, and as highly abominated by the Egyptians.

The pheasants of Mingrelia, the largest and finest known, were much esteemed in ancient times. The ancients pronounced the flamingo delicious; the moderns, on the contrary, esteem it unsavory. The crane, so delicate while young, constituted one of the dishes at Roman banquets. Pork was not eaten in Egypt; and mutton in only one of the Egyptian nomes. The wild boar was served up whole on Roman tables, and Juvenal calls it "an animal born for the sake of banquets." The mullet, taken near Sinope and Abdera, was held in high repute. The Romans fattened and consumed snails in great quantities. The lamprey, the "Helen" at banquets, was carefully reared by the Romans in fish-ponds, and taught to be obedient to the human voice. Hortensius wept at the death of one, and Antonia adorned another with pendants. Anaxandrides says that the Thracians ate butter, which, at that time, was considered by the Greeks as a wonderful food. Strabo informs us that the Lusitanians used butter instead of oil; and its use by the Ethiopians is confirmed by both Strabo and Ludolphus. Dioscorides says that butter might be employed in pastry, and poured over vegetables like oil.

Vinegar, mixed with water, was a common drink among the lower classes in Rome. Ale or beer, almost unknown to Greece and Rome, was very generally used among the surrounding nations. Ale was made of barley, wheat, oats, millet, rice, panic, spelt, and grain of every species. The Egyptians, according to Herodotus, commonly drank "barley wine," which,

according to Diodorus Siculus, was nearly equal to wine in strength and flavor. The Iberians, the Thracians, and the people in the north of Asia Minor, placed beer before their guests in large bowls or vases. The Greeks mingled their wine with the juice of the fir tree. The Greeks and Romans cooled their wine with ice.

In very early ages, the custom of dining in public extensively prevailed among the Greeks. The practice existed in Megara and Corinth, and, at a still earlier period, according to Aristotle, among the Enotrians and Carthaginians, who were not Hellenic nations. Each town of Crete, according to Dosiades, had a public building for lodging strangers, and a common hall for the citizens. The citizens were divided into messes, and the meals distinguished for simplicity and temperance. The boys were seated near the men, and cheerfulness was kept up by music. The repast was followed by conversation upon public affairs and illustrious men. Every head of a family in Sparta must contribute his portion of the cost, or be excluded from the public tables. The guests were divided into companies, and the vacancies filled by a unanimous election. No person, not even a king, was excused from attendance, except for satisfactory reasons; and the absentee, when on a chase, must send a present to his table. Black broth, with pork, was the principal fare; and the contribution of each member was settled by law. The dessert was often supplied by presents of game, poultry, fruits, and delicacies which no one was allowed to purchase. Sobriety was supplanted by lux-

ury, and Agis lost his life in his attempt at reformation.

Thucydides informs us that every city of Attica had a city hall. As the house of each family was its home, so was the public hall of each state the common home of all its members. In the public hall of Athens, in which a fire was continually burning, the city exercised the duties of hospitality to strangers and citizens. Foreign ambassadors were entertained in it, as well as Athenian envoys on their return home from a successful or well-conducted mission. It was used for the entertainment of the successive presidents of the senate, together with those citizens who, for personal or ancestral services, had their meals furnished at the public expense.

The lower classes of Egypt lived upon cheese, plants, roots, and the ordinary fruits of the country. A succession of onions, cucumbers, melons, leeks, garlic, figs, and grapes, was introduced at private and public festivals. While the dinner was preparing, the guests were entertained with sherbets, music, dancing, and conversation. Oxen, kids, goats, gazelles, onyxes, geese, ducks, widgeons, and quails, were served up by numerous servants. The table was furnished with loaves of bread, and rolls sprinkled with aromatic seeds.

The ordinary food of the Greeks was mallows, cabbages, beans, lentils, and barley cakes. They used pungent herbs, with eggs, oysters, wine, honey, and various sweetmeats. A meal was taken early in the morning, a luncheon at noon, and a dinner late in the day. The first course at Athens was fish, poultry, and

meats, attended with garlands and perfumes. The second course consisted of fruits, sweetmeats, and confections.

The luncheon of the Romans consisted of delicate fish, with the choicest wine sweetened with honey. The courses at dinner, their principal meal, frequently amounted to seven. Their stimulants were eggs, hot sausages, Syrian prunes, and pomegranate berries. They served up pheasants, thrushes, ducks, turtles, flamingoes, chars, turbots, sturgeons, mullets, and eels garnished with sprawns. They stewed the liver of capons in milk, and prepared fungi, truffles, and mushrooms, with the sediment of wine. Heliogabalus had his "peacocks' brains," "tongues of nightingales," and "oysters from the distant shores of Britain." "The most exquisite dainties," were provided for the emperors; "birds of the most distant climates, fish from the remotest seas, fruits out of their natural season, winter roses and summer snows."

Carving, according to Petronius, was taught as an art, and performed to the sound of music with appropriate gesticulations. The pantomimes, who performed by gestures and attitudes, and organs, with their elegant mechanism and mellow tones, were employed to gratify the Romans at splendid entertainments. Suetonius mentions a supper-room in the golden palace of Nero, consisting, like a theatre, of shifting scenes, to change with every course. One supper of Lucullus cost one hundred thousand francs, and his fishes sold for seven hundred thousand more. A breakfast of Heliogabalus cost four hundred thou-

sand francs; a dinner, one million eight hundred thousand. Æsopus swallowed a pearl worth two hundred thousand, and his son dissolved precious stones for drinking at entertainments. Apicius devoured fourteen millions, and, finding less than two millions remaining, the fear of starvation drove him to suicide.

VI. The ancients exhibited a diversified taste in their horses, trappings, vehicles, insignia, games, and music. The time of the Athenians was consumed in attendance upon festivals and public courts. The public interest was absorbed in splendid ceremonials, gorgeous solemnities, and dramatic representations.

1. Almost every classic writer alludes to the preference given to white horses in ancient times. The chariot of Jupiter, in the memorable march of Xerxes against Greece, was drawn by eight white horses brought from Armenia. The Germans, according to Tacitus, consecrated white horses to sacred uses; and in Sicily and Rome, white horses, according to Livy, were esteemed above all others. Horace praises white horses on several occasions; and Virgil lauds the glossy coats of the white horses of Turnus.

2. The saddle-blankets of the ancients were splendid, and the girth was made of the richest materials with the most elaborate embroidery. The Asiatics covered their horses with beautiful palls, and made bridle-bits of gold set with jewels. The yoke, besides its costly materials and carvings, was decorated with elevated plumes and figures. The Romans adorned their favorite animals with splendid necklaces, and the emperors exhibited unrivaled splendor and magnificence in their triumphal processions.

The persons sent on special missions wore golden crowns, and drove into the city with a handsome chariot and splendid retinue. Nicias is reported to have incurred great expense on his embassy to Delos; and Alcibiades astonished the spectators at Olympia by the magnificence of his equipage, and the profuseness of his expenditures. The embassies sent by the Athenians to Delphi, were particularly brilliant. The wealthy vied with one another in the number and splendor of the horses and chariots which they sent to the games. The victor, on his return home, entered the city in a triumphal procession, in which his praises were celebrated in the loftiest strains of poetry.

3. Gigs were kept for hire along the Roman roads, and covered carts were used by magistrates and distinguished females on public occasions. The open carriage which was derived from Britain, was used for convenience; and a traveling car, resembling the Belgic chariot, contained many persons with their baggage. Splendid carriages, furnished with soft seats, carried the vestal virgins and Roman matrons in the sacred processions. A very commodious vehicle for traveling was used by the kings and satraps of Persia; and the one used for conveying the body of Alexander from Babylon to Alexandria was two years in constructing, and was described by more than one historian. The Phrygians sometimes drove ten horses to a vehicle, and four-wheeled carriages were used by distinguished Romans. Chariots were kept by great families, as indications of rank or as memorials of triumph. The body of the triumphal

car was enriched with gold, ivory, paintings, and sculptures.

4. The sceptre was originally a wooden staff, which, on becoming an ensign of authority, received various emblematic devices. It was used by kings, princes, judges, heralds, priests, and seers. The Persians distinguished those of rank and authority as the sceptre-bearing classes. The ivory sceptres of the kings of Rome were surmounted by an eagle, and descended to the consuls.

The diadem, even in its simplest form, is an Oriental decoration. Alexander adopted the diadem of Persia, the ends of which fell upon his shoulders. Tacitus speaks of the Euphrates rising in waves "white with foam so as to resemble a diadem." By the addition of gold, pearls, and precious stones—by a continual increase in richness, size, and splendor—a bandage was converted into a crown, the badge of sovereignty in Europe. It was worn as a festive, funereal, civic, or military decoration. The golden crowns which were given for the performance of certain actions, were, according to the action performed, decorated with beaks of ships, turrets, or palisades. A radial crown was worn by the emperors of Rome; and the triumphal crown of gold and jewels, was large and massive. The Etruscan crown, imitating oak leaves studded with gems, was decorated with golden ribbons or ties.

The throne, besides a variety of ornaments, was covered with splendid drapery. The peacock throne of India was decked with the richest jewels. The ensigns of regal dignity among the Romans were a

golden crown, a highly ornamented chair, an ivory sceptre, a white robe with purple embroidery, and twelve attendants with an axe in a bundle of rods. The magistrates of municipal towns sat, on public occasions, in a large bronze chair inlaid with silver, and surmounted with a richly embroidered parasol.

The Greeks fixed on the middle of their shield the gorgon's head, and surmounted its border with golden tassels. By the later poets and artists, the ægis is represented as a breastplate covered with metal in the form of scales. A boss, disc, or crescent, was attached to the dress or armor, or depended from the harness of horses, for making a terrific impression. The helmet, ornamented with sphinxes or griffons, was surmounted by a handsome and imposing crest.

5. "On some occasions," says Gibbon, "the whole furniture of the amphitheatre consisted either of silver, or of gold, or of amber." "The nets designed as a defence against wild beasts, were of gold wires; the belt or circle which divided the several ranks of spectators, was studded with a precious mosaic of beautiful stones." "Large trees, torn up by the roots, were transported into the midst of the circus. The spacious and shady forest was immediately filled with a thousand ostriches, a thousand stags, a thousand fallow deer, and a thousand wild boars." This game "was abandoned to the impetuosity of the multitude;" and "they slew on the succeeding day a hundred lions, an equal number of lionesses, two hundred leopards, and three hundred bears." On another occasion, "twenty zebras displayed their elegant forms and

variegated beauty." "Ten elks, and as many camelopards, the loftiest and most harmless creatures which wander over the plains of Sarmatia and Ethiopia, were contrasted with thirty hyenas and ten Indian tigers, the most implacable savages of the torrid zone. The unoffending strength of the greater quadrupeds was admired in the rhinoceros, the hippopotamus of the Nile, and a majestic troop of elephants."

The pomp of tournaments and hunts characterized Europe in the middle ages. The prime minister of England had mules housed with scarlet, gold service upon his side-board, and nobles following in his train. He had "great stores of rich stuffs, as whole pieces of silks of all colors, velvets, satins, musks, taffeties, grograms, scarlets, and divers rich commodities." His gallery, "in expectation of the king's coming," was hung with gold, silver, and rich cloth.

6. "The flute, harp, sackbut, and dulcimer," mingled their tones on the plain of Dura; and a chorus of singers with various instruments, celebrated the praises of the Most High in Solomon's temple. The Greeks employed both vocal and instrumental music at banquets, religious festivals, and social assemblies. The ancient chorus consisted of the whole city, which met to offer thanksgivings in hymns and dances. Harps, hymns, and choruses, according to Homer and Hesiod, were employed in bridal processions. The chorus, being connected with their military organization, received its full development in the Doric states. In the earliest times of Rome, mention is made of hymns and flutes in triumphal processions and funereal solemnities. Actors brought from Etru-

ria danced to the notes of the flute; and certain flute players, according to Livy, having deserted, were brought back by an amusing stratagem. The Roman flute players, according to Valerius Maximus, were incorporated into a college. Ambrose introduced antiphonal singing, consisting of progressions with different species of the diapason, into the Christian church at Milan.

The Pandean pipe, the instrument of the Arcadian shepherds, was admitted at dances; and the organ, formed by a series of pipes, has become celebrated in ecclesiastical solemnities. The tibia, similar to the modern flageolet, was common among the Greeks, Romans, and Phœnicians. The Phrygian pipe was adapted to funereal solemnities; the Lydian pipe, to battles and triumphs. The Thebans regarded the pipe with admiration; the Athenians, with indifference. The sistrum was the mystical instrument of Egypt; and the tympanum, resembling a modern tambourine, was employed in the orgies of Bacchus and Cybele. The cymbal was in common use among the Jews, Phœnicians, and Romans. The Romans used the horn for signals; the trumpet, for proclaiming the watches. The music of the harp was considered by the Athenians as an exotic refinement, and was only known to the early Romans as a luxury brought over from Asia. The lyre, a manly instrument, was only played as an accompaniment to songs, and has given its name to a species of poetry.

Music was united with poetry, rehearsals, and imitative gestures. As musical contests were regarded by the Greeks as valuable means of intellectual improve-

ment, the competitors were required to possess natural abilities, laborious preparation, practical knowledge, modulated voices, and skill upon musical instruments. Greek literature had its origin in the performances of the rhapsodists, which were accompanied with music. "The tragedies of the ancients arose, by degrees, out of the peculiar national chorus and festival song." The chorus formed "an inseparable part of the ancient tragedy;" and perfect harmony between the choral and dramatic part, was an indispensable requisite. As the higher ranks of females joined in the public hymns and dances, no pains or sacrifices were deemed too extravagant for bestowing upon them elegance of shape and gracefulness of motion; no expense was deemed too costly for endowing them with the requisite arts of modulating their voices and measuring their steps.

The ancient romances, which were neglected by the refined Athenians, continued to delight the Grecian peasantry. While Virgil was describing the sports of rustics, those very rustics were singing their wild Saturnian ballads, a species of poetry which furnished the annalist with materials for prose. The description of the removal of the Fabian house to Cremona, is one of the finest passages which adorns Livy's splendid history. The actions of the ancient Gauls, according to Lucan, were commemorated by their bards; and the vengeance of the spouse of Attila, for the murder of Seigfried, was celebrated in rhymes still revered in Germany. The exploits of Athelstan were commemorated by the Anglo-Saxons; those of Canute, by the Danes, in rude poems. The chants of the Welsh

harpers preserved, through ages of darkness, a faint and doubtful memory of Arthur; and, in the Highlands of Scotland, are still gleaned some reliques of the old songs about Fingal and Cuthulin. The long struggle of the Servians against the Ottoman power, was recorded in martial lays; and the deeds of the Incas of Peru, according to Herrera, were celebrated by the bards in verses which the people committed to memory. The feats of Kurroglou, the great freebooter of Turkistan, were recounted by himself in ballads which are known in every village of Northern Persia. Minstrelsy attained a high degree of excellence among the Castilians; and Mariana, the classic historian of Spain, relates the story of the marriage of the two daughters of the Cid. The bards of Sandwich Islands recite the heroic achievements of Tamhamaha; those of Central Africa, the victory of the chief of the Jaloffs over the tyrant of Foota Terra.

VII. Personal decorations, indicating rank, office, and condition, display the peculiar taste.

Before the introduction of weaving, the Europeans were clothed in skins. The fox-skin was worn only by barbarous tribes; the goat-skin by common laborers in civilized nations. The sheep-skin was the ordinary clothing of the Helots in Lacedæmon, and of the poor laborers in the other Grecian states. As civilization advanced in Greece and Rome, skins were only used for clothing couches and slaves. The northern nations used skins in the highest ranks of society; and the ermine of Armenia, from its softness and deli cacy, was made into robes for the Persian nobility. The fawn-skin was enriched with gems; and the leop-

ard's skin, so admirable for its spots, was worn by the Egyptian priest.

Goats' hair mixed with fur, according to historians and poets, was manufactured into coarse felt in northern Europe and Asia. The black tunics of the Cimbri, the winter dress of the auxiliary cohorts, and the clothing of the Roman legions in Britain, were made of felt. Seneca speaks of dresses made of feathers, and Vitruvius mentions artificers who worked in feathers. Goats' hair was the chief ingredient of clothing among the Scandinavians, who, after the introduction of the distaff, plaited the thread into ribbons, sewed them together and formed check dresses, which were so common in most nations of northern latitudes during their incipient civilization. The thread was afterwards woven into narrow stripes, and finally into broadcloth. Sackcloth was made in Lycia, Phrygia, Spain, Libya, Cilicia, and used for the coarse habits of sailors and fishermen, for tents and horse-cloths, for expressing mortification and grief.

The Greeks were clothed with wool, sometimes with linen or cotton. The white woolen dresses of the Romans were purified by the fullers, who, like most classes of artisans, formed a college. Long after silk was imported from Seres, the Romans continued to mix it with linen or wool. Cloth of this mixed nature, first fabricated at Cos, was of so loose a texture as to be denominated "woven wind." Vestments of pure silk were considered appropriate only for females; and Heliogabalus was severely censured as being the first who wore a robe of the pure material. Tibullus, Propertius, Horace, and Ovid, adorn their verses with

allusions to these elegant textures, which were sometimes of a purple dye, and variegated with golden stripes. Men aspired to be clothed in silk which cost its weight in gold, and shawls and scarfs from the remotest East accumulated in the imperial wardrobe during successive reigns.

The looms of refined nations executed patterns which vied with elegant paintings. The figures of historic and mythologic representations, made an elegant employment for distinguished females. Iris finds Helen occupied in representing, in tapestry, the evils which the Greeks and Trojans were suffering on her account; and when Andromache first heard the melancholy tidings of the death of Hector, she was engaged in a similar occupation. Splendid tints were produced by murex and saffron, and sprigs and flowers secured an almost endless variety.

The ends of the warp were separated into bundles, and transformed into tassels. Fringes, made of costly materials, were attached to garments by the Egyptians, Romans, and Sarmatians. Barbarous nations wore fringes hung with bells; and one hundred golden tassels surmounted Jupiter's mythic shield. Borders were common to both sexes in many countries; and to designate office, the border of the tunic was enriched with gold. It had the appearance of a scarlet or purple band upon a white ground, and sometimes resembled foliage or meandering scrolls. The fillet, an ordinary portion of female dress, was used to confine the tresses. Fillets, ornamented with embroidery or set with pearls, were employed as ornaments for statues, altars, temples, victims, prophets, poets, priests,

priestesses, and suppliants. The dress of the Roman matrons was gathered into broad folds, and had a flounce at the bottom. A circular robe, with a rich border at the bottom, was worn by females. The broad fillet at the bottom of the tunic, resembled a modern flounce, which, by the addition of gold and jewels, took the form of the more splendid and expensive cyclas.

Long sleeves were worn by shepherds, tragic actors, and the Celtic and Asiatic nations. They were considered effeminate by the Romans; but they were worn by Catiline, Cæsar, and Caligula. A dress with one sleeve was worn by slaves, laborers, and the chorus of old men in comic plays. Sleeves, as a separate part of dress, are mentioned as early as the Homeric age. Mittens protected the hands, and gloves were used by the Romans in certain manual operations. The Persians wore gloves and fur muffs.

The pall was usually ornamented with a fringe by the northern nations. Blankets of splendid colors were worn by females, sometimes by men who displayed a fondness for dress. A train was an ornament of Grecian as well as of oriental dress, and Alcibiades wore a blanket which trailed upon the ground. The scarf was tastefully decorated with a border, and worn by females among the Phœnicians, Trojans, Phrygians, and other Asiatic nations. Demetrius, the son of Antigonus, wore a scarf in which were represented the twelve signs of the zodiac. Shawls were used for female dress, to protect valuable furniture, to form a magnificent tent for entertainments. They displayed various symbolic and

mythologic figures, and were used in religious ceremonies, to conduce to their splendor, to explain their signification, and to veil their solemnity. Veils were worn by females; and the veil of Ilione, the eldest daughter of Priam, was among the seven objects preserved at Rome as pledges of its permanent power.

The deep purple was restrained to the person and palace of the Roman emperor. A purple band extending down the tunic, indicated the senatorial dignity. Napkins, coverlets, table-cloths, and the priests of Carthage aud Cadiz, were adorned with this badge. The Roman priest was clothed in a long white or purple robe, with his head decorated with a fillet and crown. After the toga was supplanted by the pall and lacerna, it was regarded by the higher classes as an honorable distinction. A colored dress, more easy than the toga, was worn by all classes at the Saturnalia, a season of universal relaxation and enjoyment. A crocus-colored robe was worn by the priests of Cybele, and as a gala dress by Grecian females. The Roman bride was dressed in a long white robe, with a purple fringe. A band was worn over the breast by females, and white bands were worn by men as an extraordinary refinement—a practice which was continued during the middle ages.

Strabo describes the Persian gown as "a flowered tunic with sleeves." A Gallic garment was made the court dress by the emperor Bassianus, who, from this circumstance, was called Caracalla. The Roman traveling cloak gave freedom to the arms, and a cloak with a hood was worn by herdsmen and peasants. The coarse Gallic blanket, notwithstanding its shaggy

appearance, became a fashionable garment. A thick woolly cloth was used as a wrapper; and the lacerna, an open garment, was worn over the toga in cold or rainy seasons. The lacerna was so highly decorated, that Martial mentions one which cost ten thousand sesterces. The sagum, a cloak worn by northern nations, was worn by Roman soldiers, and by all the citizens, except those of consular rank, when war prevailed in Italy.

Pantaloons were common to all the nations which encircled the Greek and Roman population, extending from the Indian to the Atlantic oceans. They are particularly mentioned among the Medes, Persians, Armenians, Phrygians, Sacæ, Sarmatians, Dacians, Getæ, Belgians, Franks, Britons, and Gauls. They were wide and ornamented, and were ludicrously described in Euripides as "variegated bags." Though pantaloons appeared so highly ridiculous to classic taste, they were adopted by the colonies on the Euxine, and came gradually into use in Rome.

Sandals, made of leaves, twigs, or fibres, according to Isidore and Tertullian, were worn by philosophers and comic actors. They were so ornamented as to become fashionable and expensive; and the sandal makers constituted a corporation or college in Rome. Those Greeks and Romans who wore shoes, indulged their fancy by inventing the greatest possible variety in form and color. They were elaborately cut, and a shoe larger than the foot was considered by Theophrastus as a proof of rusticity. Lucullus had shoes painted with spots in imitation of jewels. Senators adorned their shoes with a silver crescent. Helio-

gabalus decorated his shoes with beautiful cameos. Boots were worn by hunters, tragedians, and public officers. The leather was beautifully colored, and the paws of the animal sometimes turned down like flaps. As the soles elevated the wearer, one who had assumed the senatorial dignity, was told that his nobility existed in his heels. Slippers were worn with the scarf or pall, not with the toga. Caligula wore gold and pearls upon his slippers. Socks of fine felt were worn by the Athenians; and the socks of females were richly adorned according to the wearer's taste and means.

The felt-cap worn by fishermen and mariners, was made in a conical form, and Ulysses is represented in a cap to indicate his seafaring life. Strabo observes that the climate of Media rendered felt-caps necessary, and calls the Persian cap "felt-shaped like a tower." The felt-cap of the Greeks and Romans fitted the head, and was used in sickness, journeys, and unusual exposures. It was used in the ceremony of manumitting slaves, and became an emblem of liberty. The broad-brimmed hat, worn by the kings of Macedon, was adopted by the Romans, especially by Caracalla, who used to imitate Alexander in costume. The tiara, a hat with a large high crown, characterized the Armenians, Parthians, Persians, and other northwestern Asiatics. The Mysian hat, now called the "Phrygian bonnet," was a purple tiara with lappels to be tied under the chin. The kings of Persia wore an erect tiara; their subjects, a soft, flexible one. The king, besides his diadem, wore a splendid tiara with white spots upon a blue ground, and adorned with

gold and jewelry. The mitre, originally the name of an oriental head-dress, characterized the Phrygians. The cowl, so generally used as to be mentioned in an edict of Diocletian, was made of wool or beaver's fur, with a long nap.

A colored ribbon, called a lemniscus by the Syracusans, was worn by ladies, and showered upon persons to show honor and admiration. Lemnisci and foliage were made of gold and silver, and embellished with various devices and inscriptions. A distinct class of persons wove wreaths, garlands, and festoons, and blended the forms, colors, and scents of the most beautiful variety of leaves, flowers, and fruits, in the most agreeable manner. The streets were sometimes enlivened with these splendid and tasteful decorations. Festoons were hung about the palace, and upon the door-posts of private houses.

Euripides says that the Greeks derived their knowledge of fans from "barbarous countries." They were elegant in form and material; and, though waved by a slave, a gentleman might fan a lady as a compliment. Guests were fanned at table; and Augustus was fanned during sleep. Female servants held parasols over their mistresses; but to present a lady with a parasol, or to hold one over her head, was a common attention bestowed by lovers. The use of a parasol was considered as a mark of effeminacy in men. Grecian females, in later times, substituted large straw hats for parasols.

The diamond, "for a long time known to kings only," came into the possession of noble families. The Orphic poem commends the beauty of the opal as

having "the delicate complexion of a lovely youth." "Nonius, who possessed an opal worth twenty thousand sesterces," fled to save "his whole fortune." The sardonyx was ranked by Pliny next to the opal; and the Indian amethyst held the first rank among purple and violet-colored gems. Carnelians were brought from Babylonia; and the coral, resembling vermilion, came from India. Theophrastus speaks of the sapphire as "sprinkled with gold;" and the beryls, with which the Romans studded their cups, appear to have "a like nature with the emerald." From time immemorial, the princes of the East sought pearls for decorating their dress, instruments, and furniture. The Persians gave their weight in gold, and the Romans placed them in the second class of jewels.

Necklaces were worn by Grecian and Roman females, and by both sexes in Egypt, India, and Persia. The simplest kinds consisted of berries, spheres of glass, and amethysts, frequently modified by a row of drops hanging below the beads, and arranging themselves upon the neck like rays proceeding from a centre. Small golden lizards sometimes alternated with the drops, and a band of several rows of chain-work supported numerous pendants. The ornaments sometimes consisted of circles, lozenges, rosettes, ivy-leaves, and hippocampi; sometimes of emeralds, amber, greenish stones, and neatly-contrived clasps. Necklaces sometimes resembled serpents coiled about the neck, and their costliness was enhanced by the insertion of pearls and precious stones, strung with gold-wire and links.

Frontlets, made of steel or gold enriched with gems, were worn by both sexes in Lydia. Armlets were sometimes merely fragments of agate, carnelian, and jasper—sometimes wrought into the shape of quadrupeds, beetles, and human eyes. The Samians wore ornamental armlets at solemn festivals; and the fashionable ladies of Germany had armlets of various materials, shapes, and styles. Anklets were made of gold or silver; and greaves, of velvet ornamented with gold. Ear-rings were worn only by females in Greece and Rome; by both sexes in Lydia, Babylon, Persia, Libya, and Carthage. They were made of metal, with drops of gold, pearls, and precious stones. Brooches of gold were worn by females upon the breast, shoulders, and arms. They were succeeded by buckles, which the emperors set with gems. The caskets for keeping ladies' jewelry, were made of gold, silver, ivory, mother-of-pearl, or tortoise-shell, enriched with sculpture.

The Cassiterides, according to Strabo, wore very long beards; and the Catti, according to Tacitus, did not shave till they had performed a certain heroic action. A thick beard indicated manliness in Greece, slovenliness in Rome. The Greeks shaved in mourning; the Romans pursued a contrary practice. To go with uncombed hair, was a sign of affliction; and both sexes carefully used the comb in ordinary circumstances. The process of clipping, shaving, and perfuming, was performed by a barber, who had a great concourse daily gossiping at his shop. Nero dedicated his hair to Jupiter Capitolinus; and Statius

mentions a person who requested the composition of some verses suitable to such a dedication.

The Athenian ladies sprinkled their hair with yellow powder, crowned it with flowers, and fastened it with a golden clasp. The Roman females, in the earlier ages, dressed their hair with elegant simplicity; but, in the Augustan age, they dressed it with scrupulous nicety, colored it with gold dust, made it glossy with ointments, and adorned it with pearls, ribbons, or golden chains. They used paints, cosmetics, and washes, for improving their complexion, and powders to strengthen the gums, to assuage pain, and to beautify the teeth.

The Greeks applied Egyptian ointment to the feet, palm oil to the cheeks, balsam mint to the arms, sweet marjoram to the hair, and wild thyme to the neck. The Romans, according to Seneca, anointed themselves three times a day. Hundreds of bottles are found in Italy; and Athenæus wrote a treatise on the Roman ointments. The plebeians used scented oils; the patricians, the most costly unguents and perfumes. The traffic in perfumery was considerable in several towns in Greece and Italy; and one great street in Capua consisted entirely of shops for selling perfumes and ointments. Suetonius says that Caligula perfumed the waters of the bath; and Pliny states that Nero anointed the walls with precious aromatics.

VIII. Tablets for writing were usually made of boxwood; and waxen tablets continued in use in Europe during the middle ages. They were used by the Romans for short writings, and even for letters which were sealed like legal documents. Eumenes, king of

Pergamus, improved the manufacture of skins for writing; and the papyrus of Egypt, before the time of Herodotus, was extensively used in Western Europe. The duty on imported papyrus was abolished by Theodoric; and Cassiodorus congratulated the world on the cessation of a tax so unfavorable to commerce and learning. The back of the paper was usually stained, the pieces joined into a single sheet, the edges carefully cut and colored, and the sheet rolled upon a staff, the projecting ends of which were ornamented with balls or bosses. The volume, which sometimes contained the portrait of the author, was protected by a parchment case, stained yellow or purple.

The ink of Egypt still retains its brightness, and that of Herculaneum is still fit for use. Purple letters adorned the banners of Crassus, and the signature of the emperor appeared in red ink. Part of the poems of Nero were written with gold letters, and gold letters are found on public pillars and monuments. Ovid advises to write love-letters with fresh milk, so that they would not be legible till sprinkled with coal-dust. The ephors of Sparta had a secret mode of communicating with their absent kings and generals.

The buildings of Greece for literary pursuits were surrounded by gardens, groves, porticos, and shady walks embellished with sheets of limpid water. At Athens, every scene, every edifice, every conversation, was a living lecture of elegance and erudition. The seven liberal pursuits, grammar, rhetoric, logic, arithmetic, music, geometry, and astronomy, were so assid-

uously cultivated, that Cicero well remarked, that studious youth should go to Greece, where "they might drink from fountains rather than from rivulets." The elements of good taste, which they possessed by nature and improved by art, imparted to literature the liveliest and most attractive charm. The museum founded by Ptolemy Philadelphus, for the promotion of learning, formed a part of his palace. It contained cloisters, porticos, a public theatre, a dining-hall, and included botanic and zoologic gardens.

The vast concourse which assembled at the Olympic games, afforded an opportunity of publishing literary works. The booksellers of Rome employed transcribers, and put up the titles of their books on the shop doors. Horace rejoices that his books were not seen at the common stalls ; and Martial tells a person that a copy of his works could be obtained at Tryphon's, the bookseller. A library became an indispensable appendage to a palace ; but many gentlemen were ignorant of the precious matter contained in their splendid volumes.

Pisistratus made a considerable collection of books at Athens ; and Aristotle, aided by the munificence of Alexander, collected a still more valuable library. Attalus and Eumenes collected a library at Pergamus, containing two hundred thousand volumes. The library of Alexandria, the most celebrated in ancient times, was begun by Ptolemy Philadelphus, and afterwards enlarged to seven hundred thousand volumes, consisting of vast collections of records, histories, tracts, poems, every thing curious, valuable, or elegant among literary productions. The consuls trans-

ported many valuable volumes to Rome, and several valuable libraries were founded in the city.

Petrarch, during his life, searched two hundred libraries. Leontius, forsaking the wealth of Venice and the elegance of Florence, went to Constantinople to search for Grecian manuscripts. Nicholas the Fifth, by collecting ancient manuscripts from Byzantium, Germany, and Britain, formed a library of five thousand volumes. To his munificence the Latin world is indebted for the versions of Xenophon, Polybius, Thucydides, Herodotus, Appian, Strabo, Homer, Plato, Aristotle, Ptolemy, and Theophrastus. Cosmo of Medicis, a name almost synonymous with the restoration of learning, dedicated his riches to literature.

The moderns exhibit a great diversity in their edifices, arts, sepulture, furniture, food, equipage, apparel, and literature.

I. A vault of ice, containing several rooms, serves the Esquimaux for a dwelling. The inhabitants of the Aleutian islands live in warm houses underground, containing more than one hundred persons. The Highlander of Scotland covers his hut with turf, over which the grass grows so as to resemble a green hillock. The Laplander rears a mound of turf and sticks; the American Indian covers several poles with buffalo robes; and the wandering Arab stretches his light canvas tent upon the desert. The houses of the Caribs are built of poles tied together with bark strings. The earthen floor of their church is strewed with pine leaves, the sides trimmed with branches and festoons, and the altar ornamented with fig-leaves and floral wreaths. The Madawascans cover their huts

with pine bark ; the New Mexicans, with a terrace of sod upon logs. The houses of the Feejees are closed with small canes, and thatched with sugar-cane and fern leaves. The Hindoo builds a slight wicker-work house, and the inhabitants of Lima cover their houses with reeds or coarse cloth.

Grace church, in New York, has the form of a cross, with a lofty spire. The white marble of the exterior is admirably adapted to exhibit the rich tracery and architectural forms. The style, a tasteful variety of the richest Gothic, is little known to the architects of England, and was never before attempted in the United States. The interior is finished with elaborate ornaments, and colored to resemble the stone which was used in sumptuous buildings in the middle ages. The windows are divided by mullions and intricate tracery, and fitted throughout with glass, either stained in the fire, or colored with the molten liquid. Although the church is so rigidly symmetrical in form, the ornamental parts are beautifully varied, and the patterns of the glass are almost endless in variety.

The Turks of Asia erect costly baths, and build caravansaries for refreshing pilgrims. The bath is now prevalent from the villas of Italy to the chateaux of France—from the castles of Germany to the palaces of Muscovy. Edifices, with magnificent ornaments, arose during the splendid reign of Napoleon ; and the visit of the sovereigns of Europe to Paris, gave a new impulse to the art. The architects have adapted their style to useful as well as to tasteful purposes ; and the chief cities of England, Russia, and Switzer-

land, partake of this useful style, without a sacrifice of classic proportion and purity. The Italian style aims at shade; the French style is nearly all window.

Naples, which is noted for the number and richness of its palaces, contains four hundred churches. The grotto, to facilitate intercourse between Puteoli and Naples, is cut through a hill, and has apertures and suspended lamps for furnishing light. The principal streets of Bologna are lined with arcades or continued porticoes. Venice has one hundred and forty-nine canals, spanned by three hundred and six arched marble bridges. Its architecture is a mixture of the Gothic with a redundant ornamental Arabic. The palace of the doge, of all orders, is rich in mosaics, statuary, and columns of porphyry, serpentine, veined, and other marbles. The palace on Isola Bella has a suite of subterraneous apartments fitted up like a marine grotto, tastefully incrusted with shells, rock-work, and stalactites. The garden on an elevated terrace is crowned with flowers and statuary, and redolent with fragrant plants. The walls of the Duomo at Pisa are adorned with various marble columns, a mixture of Grecian and Arabic blended in the style. The dazzling array of white walls, in the enchanting plains of Italy, is nothing but stucco daubed upon coarse stone edifices.

Aqueducts, an interesting feature in modern Rome, have allegoric figures, statuary, splendid colonnades, magnificent basins, and foaming columns which descend in copious showers or wreaths of spray. One of them, which cost a million of dollars for its repairs, has the statues of Moses smiting the rock, and Aaron leading

the Israelites to drink. The palace at Florence is connected with public grounds planted with shrubbery of evergreens, so that the winters are dressed in beautiful foliage. The apartments are set off with elegant tables, the walls are entirely covered with paintings, and one room has a magnificent frescoe painting on the ceiling. The mouldings are gilded, the wainscoting is of rich silk tapestry, and all the furniture is in a corresponding style. One table for the royal chapel, ornamented with the variegated colors of the most beautiful stones and gems, employed twelve persons for eight years. The chapel has employed three hundred men, at a time, for more than two hundred years. It is an octagon literally encased with marble and precious stones.

Paris is a continuous succession of splendid avenues, streets, parks, gardens, palaces, monuments, and triumphal arches. The dome of the finest church is surrounded by thirty-nine columns, and supported by heavy columns ornamented with pilasters. The interior is adorned with one hundred and thirty fluted Corinthian columns. The court of the Hotel des Invalides, is surrounded by four piles of buildings, constituting the refectories, lodgings, and public saloons. The water of the city costs the citizens nearly one million of dollars annually. The Tuileries, containing seventy acres, are ornamented with elegant statuary, and adorned with gravel walks, shady trees, and comfortable seats. The palace of Versailles, including its inclosure, cost about two millions of dollars.

Amsterdam is noted for its ship-yards and canals.

Moscow contains a bell weighing two hundred tons; Harlem, an organ with eight thousand pipes. In France lofty trees ornament the public roads, private lanes, and meandering water-courses. The traveler passes "for several days through almost one continuous avenue of cherry-trees, from Strasburg by a circuitous route to Munich." "In Moravia the road from Brun to Olmutz, passes through such an avenue, extending upwards of sixty miles."

A Hungarian village has two rows of cottages along a muddy road, intermingled with marble palaces towering to the skies, surrounded by gardens, fortresses, and terraces, and decorated with fountains, statues, and costly pictures. Small wooden huts contrast with superb edifices, in Petersburg and Moscow. The narrow, ill-paved streets; the low, gloomy houses of Constantinople, contrast with its gilded domes, elegant minarets, and splendid mosques. In England, the castle with porter's lodges, magnificent gates, and extensive parks, contrast with the hut with a few plants in front, a vine running over the door, and a flower blooming in the window.

Churches, monasteries, and nunneries, cover nearly half the ground of Bogota; and the decorations of the churches exceed those of the most gorgeous temples of the Incas. One statue is ornamented with one topaz, one hyacinth, fifty-nine amethysts, one hundred and seventy-two pearls, one thousand two hundred and ninety-five emeralds, and one thousand three hundred and forty-eight diamonds. The houses of Guatimala are only one story high, and have doors and windows protected by iron balconies. A large stone fountain

in the centre of the city, is supplied with water from the mountains. The church of Esquipulas has a lofty portal, a nave separated by pilasters, a lofty dome, walls adorned with pictures, recesses filled with statues, a pulpit covered with gold leaf, an altar protected by an iron railing with a silver balustrade. The city of Mexico is adorned with fountains and public edifices. Scarcely anything is expended for education, while one hundred millions of dollars are locked up in church ornaments.

A Chinese street is covered with boards or matting, and appears more like a bazaar than a highway. The sides of the edifices are displaced; and the tempered light admitted above, displays "silks, satins, crapes, porcelain, preserves, lacquered ware, screens, snuff-boxes, chess-boards, ivory, carvings," and fanciful trifles. The better classes of houses in the retired portions of cities, are surrounded by high walls, and contain numerous apartments with several paved courts. The dwellings of the poor have earthen floors, and roofs of bamboo matting. The whole country is an almost continuity of cities; and the suburbs of great cities are formed by large and populous villages. The paint of the houses has a glossy brightness. Private houses have no windows towards the street; and a mat before the door prevents the public gaze. Many vessels are floating houses for accommodating whole families.

The gardens in the suburbs, are entered by circular gateways, and adorned with roses, camellias, and shrubbery. In the miniature valleys, "lakelets spread out filled with lilies growing in their native element, and

swarming with gold-fish, which chase each other among the blossoms." Slender bridges, the lines of which seem to be spun of gossamer, are hung over the narrow streams. Summer-houses of bamboo and cane, are twisted into every grotesque shape, and laced with creepers of the brightest verdure. The dwellings have plainness and simplicity, except the grotesque carvings and gildings. The saloon of domestic privacy has a peculiar sacredness; and the light stealing through the aperture above, imparts a calm and quiet beauty. A marble table stands between two rows of ebony chairs; embroidered silk lanterns depend from the ceilings; and pictures and scrolls, valuable as family reminiscences, hang around the olive-colored walls.

II. In the splendid museum of Florence, the busts of eminent men, ancient sarcophagi, bronzes, medals, inscriptions, and gems of various forms, are concentrated into one cabinet. The works of the most celebrated artists of ancient and modern times, are arranged in three long corridors, the ceilings of which are painted with elegant frescoes. Paris contains more than twenty galleries and museums of the fine arts. The Louvre is replenished with thirteen thousand paintings; and a museum contains engravings, drawings, models, and galleries for modern and Egyptian sculpture.

The museum of Naples contains antiquities from all parts of the world, and in almost endless variety. A hall is devoted to paintings, mostly illustrative of heathen mythology and historical events. The gallery of ancient sculpture, comprising twelve depart-

ments, contains over six thousand specimens. The Etruscan and Egyptian gallery contains sepulchral monuments, vases, armor, and mummies. A gallery of antique bronzes of great variety, contains a bust of Seneca, whose face exhibits deep and philosophic lines. Among a labyrinth of rooms, two are appropriated to foreign and Neapolitan paintings, amounting to several thousand. A gallery contains the antiquities found in Herculaneum and Pompeii. A cameo, on which is sculptured the head of Medusa and the marriage of the river Nile, is one foot in diameter, and is valued at one hundred thousand crowns. Cameos, intaglios, seals, jewels, and gems, attract the visitor with a spell which he is unwilling to dissolve.

III. The pure taste of Chantry, in the cathedral of Litchfield, has thrown a beauty over death. The mother sees her beloved children clasped in each other's arms, almost realizes her past happiness, and would fold the treasure to her bosom, did not the cold embrace dissipate the fond illusion. Duty is not considered as performed "while a single motive is not made to play upon the actions of human life, while a single rill of comfort is not made to flow in upon the waters of affliction."

One of the cemeteries without the walls of Paris, contains one hundred acres. The sepulchral plants are kept in perpetual verdure; and nearly all the monuments are hung with wreaths, either of natural or artificial flowers. The living feel almost willing to lay themselves down in the marble tomb, over which the honeysuckle wreaths its fragrant blossoms, around which the rose and hyacinth distil their redo-

lent dew, and upon which friends record their love in the enduring tablet. A dictionary of illustrious men, set off with all the fascinations of art, enforces the most vivid and intimate associations.

Mount Auburn, near Boston, is so contrived as to make the couch of death a garden of beauty. The intersecting avenues are graveled, and planted on each side with trees, flowers, and ornamental shrubs. The solemn beauty which pervades it on all sides, and the unbroken silence which reigns around, almost reconciles the meditative spirit to "that bourne from which no traveler returns." Other American cities have established cemeteries in quiet and beautiful retreats.

IV. The female Greenlander arranges the furniture with neatness, hangs up before it a white curtain containing figures in needlework, and fastens her pincushion and looking-glass to this ornamental drapery. The long galleries at Havana are hung with green curtains, and adorned with crystal lustres. The beds have white curtains, and the embroidered pillow-cases are tied with rose-colored ribbons. The cambric towels are trimmed with lace, and sacking bottoms covered with damask. The higher classes of the Greeks and Turks, repose upon sofas with muslin trimmings and ornamental quilts. The Dutch lady covers her beds and tables with fine linen, adorns her rooms with pictures, and embellishes her yards with beautiful flowers.

The East Indians suspend from their ceilings the epidendrum, which continues to put forth yearly elegant leaves and fragrant flowers. The Pelews form

their knives of marine shells, and their drinking-cups of cocoanut shells. In France, mirrors are framed into the walls, and regularly let with the apartments. Some pieces of tapestry, containing the designs of the most celebrated pictures, are in the loom for six years. Their houses have porcelain vases, cups, pitchers, urns, figures, statues, toys, and chimney ornaments.

V. The Brahmin is satisfied with vegetables; the Norwegian, with the coarsest bread; and the Hungarian magnate, only with the richest delicacies. Dogs are eaten in China; locusts, in Arabia; and snakes, mice, lizards, and caterpillars, in Africa. Sloths, monkeys, armadillos, alligators' tails, and wild fowls, constitute the Brazilian food. In China, "fish-bones, orange-skins, grape-stems, peelings, and entrails," are disposed of "in stalls devoted exclusively to their sale." Horse-flesh is the favorite food of the Tartars, and fermented mare's milk is their favorite beverage. The Kamschatdale regards putrid fish as a luxury, and the Gypsies seem to relish food in proportion as it approaches putrefaction.

The opulent Swede furnishes his table with profuse and costly collations. The dinner at Havana often costs two or three thousand dollars, when distinguished guests are invited on special occasions. A Prussian lady, that she may indulge herself in French millinery, keeps the most frugal table. The parsimonious food of the opulent Italian, allows a magnificent display in splendid houses and elegant furniture. The Greek places a circular tray upon a stool, and his dinner consists of twelve dishes presented singly.

The table of the Chinese merchant is covered, like an archipelago, with numerous islets of plates and dishes filled with disguised culinary compositions. The greatest dainties are "the larvæ of the sphinx moth," "the grubs of sugar-cane," "salted earth-worms," "pigeons' eggs," "birds' nests," and "castor-oil beans." Suing, a fermented liquor made of rice, is served from silver flagons; and the guests are presented with "Japan leather," "jellied deers' sinews," and rice flavored with the juice of birds' nests. The courses are so multitudinous, that the plates are piled upon each other's edges in pyramids. The table is cleared, polished, and spread with new sets of rare porcelain for the dessert. "Cakes and sweetmeats, oranges of the mandarin and emperor species," shaddocks with curiously-carved rinds, "bananas, plantains, plums, grapes, and chestnuts," are piled up in pyramids and "crowned with flowers." Servants fling jasmine over the guests, and supply them with damask napkins steeped in scented roses. After tea, wine, and segars, a curtain is drawn, disclosing actors in brilliant costumes, amid a dazzling display of fire-works. A salute of music follows; then a Chinese tragedy, in which the passions are expressed in drawling recitative, prolonged groans, monotonous howls, petulant barks, and testy squeals. The intervals of the drama are filled up with clashes of cymbals, gongs, and kettle-drums. The curtain falls, conversation recommences, a clash of drums resounds, the curtain rises, and actors exhibit "their feats of leaping, tumbling, strength, and agility."

VI. The king of Sardinia goes to church with two hundred military officers, who shine with gold and

silver trimmings and epaulettes. The grooms are dressed in flaring red; the pages of court are dressed in small-clothes, with white silk stockings; and the queen appears in a white satin dress, inwrought with silver. The Neapolitan nobility, possessing scanty revenues, use gilded carriages lined in the richest style, drawn by eight horses, preceded by two running footmen, and followed by four servants in the costliest livery. The manes and tails of their horses are ornamented with feathers, ribbons, and artificial flowers. The Japanese girdle is richly ornamented with a coat of arms. The Burmese amuse themselves with boat races, theatrical representations, and splendid illuminations. The towns of England, though the peasantry live in poverty, are provided with theatres.

The Roman pontiff, in religious processions, is clothed in the most splendid robe, seated in a chair trimmed with crimson, and elevated upon the shoulders of twelve porters. At religious celebrations in Guatimala, the bells are rung, cannon fired, and rockets set off in the streets. Arches, decorated with evergreens and flowers, extend across the streets, which, at the same time, are strewed with pine leaves. The windows are decked with silk curtains, and flags with various devices. The altars are covered with arbors of evergreens, and adorned with pictures. The men appear in their best attire; the females, in black mantillas; the boys, in white frocks, pantalets, and vails; the priests in costly garments, bearing golden candlesticks with lighted candles.

The Pelews ornament their canoes with red shells, and the Arsasides decorate their boats with consider-

able taste. The canoes of the Feejees have large outriggers ornamented with shells, and carry an immense sail of white mats, with pennants streaming from the yards. The piroques of the Madawascans, though without cushions or seats, are embellished with rude designs and decorated with flags and ribbons. The boats of the Chinese are often splendid, and European ships have cabins fitted up like elegant palaces.

VII. The peasants of each province of Europe have peculiar costumes, which descend through successive generations. The Piedmontese women wear a cap of lace and frills, which "looks as if a strange bird had alighted upon the shoulders." The peasantry of Modena place a miniature straw hat upon the head; the Tuscans, on the contrary, wear one as large as an umbrella. The females of Genoa never appear in the streets "without a light scarf of white gauze thrown over their head." The Bernese female wears a black velvet bodice highly ornamented, blue skirts bound with red, a black collar ornamented with white metallic chains, a black ribbon hanging from the hair to the ground, and a black silk cap with a high gauze border running up in a waving circlet. The Swiss girls insert into their hair a braid of white cotton cloth, and, for grand occasions, a silk braid is fastened to the back of the head with a gold or silver pin. The matrons comb their hair straight backwards, gather it into a knot, and fasten to it two wings of stiffly-starched cambric. The dress of the Swedes is regulated by law, but the mountaineers retain their primitive costume.

The female peasantry of Poland display a tawdry patchwork; the middle classes, much simplicity; the

nobility, much pomp and magnificence. The gentry of Bohemia wear a green waistcoat embroidered with silk, a broad leather girdle, brown pantaloons, and a linen cap edged with lace and embroidery. The court ladies keep many maids to supply them with coffee, to dress them differently every day, and to wait upon the cats and parrots in the hall. The Hungarian ladies fasten their belts with pearls or diamonds; the peasantry wrap over their jackets a sheepskin retaining the wool.

The muslin dresses of the ladies of Havana, are richly embroidered and trimmed with lace. The negro who leads the orchestra, wears a swallow-tailed coat, yellow small-clothes, silk stockings, kid shoes with pink roses, and lace-ruffles upon his hands and breast. The Dutch lady wears a large hat pendant on each side, and a cap with gold filagrees twirling over her cheeks like tendrils. The Feejees supply a deficiency of hair with wigs, and paint their faces a shining black, relieved with vermilion spots. The girls wear their hair in ringlets; but, after marriage, the female frizzles it out, and the preparation of ashes, in which it is steeped, runs down her cheeks in zigzag lines. They oil their children, and anoint themselves to impart an orange hue. The chiefs wear large turbans, and the length of the pendant girdle denotes the rank of the wearer.

The Chinaman puts a grass cloth next to his body, and cases his limbs in huge galligaskins tucked into large heavy cotton stockings. In the tops of these casings, he stows away his fans, purses, samples, and snuff-boxes. His satin shoes are turned upwards at

the toes like skates, and have white soles three inches in thickness. A close double-breasted jacket, with wide sleeves, is buttoned across his breast; and a loose tunic, clasped in front with golden buttons, extends to the ground. He has a shaved head, a pendant cue, and a protecting fan. Long nails, the evidences of laborless gentility, are inclosed in cases to prevent fracture. The lower classes of females wear trowsers; and the well-bred appear as if clothed in many night-gowns. Her cap is decorated with jewels and costly embellishments. Her long nails are twisted into spiral curls, her eyebrows shaved, and her whitened cheeks dotted with vermilion. Her waist is without a zone; but, instead of a civilized pressure upon the vitals, her feet are crushed into a deformed lump.

The female Abyssinian wears rich silk ornamented with jewels; and the Hanoverian ladies appear at court in rich furs decked with diamonds. The Moors use red slippers, and decorate their hair with coral beads. The Persian female wears a velvet robe fastened with gold buttons, and ornamented with jewels. The Greeks wear long flowing robes, and decorate their heads with flowers. The merchants and nobility of London, make a display of diamonds and pearls equal to the Asiatic princes. The Indians of Prince William's Sound, though clothed in undressed skins, hang ornaments from their noses and upper lips.

A Turkish lady wears trowsers of rose-colored damask brocaded with silver, and white kid shoes embroidered with gold. Her white gauze robe is edged with embroidery, and closed at the neck with a dia-

mond button. Her white waistcoat has long sleeves, and is edged with a broad gold fringe. Her damask robe has a girdle richly adorned with pearls and precious stones. Her loose robe is composed of rich brocade lined with ermine and sable. Her head-dress is made of silver stuff pointed like a mitre, the end hanging down with a golden tassel. Her hair is divided into tresses, braided with ribbons, and decorated with pearls, flowers, and diamonds.

The peasantry of Norway, who dwell in earthen huts, wear belts adorned with brass plates, flapped hats ornamented with ribbons, and clothes filled with jingling trinkets. The Icelandic female, living in a turf hut upon coarse food, wears a girdle of black velvet, and decorates her dress with large silver clasps. The Circassian, living on millet-paste and reposing upon a felt-bed, uses pockets ornamented with embroidery, and clothes bound with lace. The Portugese female, who lives on bread and pilchards, wears fine boots and golden trinkets.

The Papuese, who are houseless, are noted for tawdry finery; and the New Caledonian, who dwells in a house resembling a bee-hive, uses artificial ornaments. The Ceylonese, who live within clay walls, are very fond of personal splendor; and the Lapp, whose hut resembles a bakeoven, wears a cap of blue silk embroidered with lace. The Finn, whose dwelling looks like a pile of timber, wears white pantaloons, a yellow sash, and buskins with scarlet garters ending in a black tassel. The female wears a scarlet vest brocaded with large flowers. The Russian fe-

male, living in a mean hut, decorates her hair with pearls.

The Polynesians wear a hoop of wood, a head-dress like a helmet, and a diadem set with mother-of-pearl. When first visited by Europeans, they showed the most lively joy on the presentation of any new commodity, and successively desired nails, mirrors, whistles, knives, beads. The New Hollander puts a bone in his nose, and a shark's tooth in his hair. The inhabitants of the Carolines decorate their heads with feathers and flowers, suspend aromatic herbs from their nostrils, and hang plaited palm leaves to their ears. Both sexes, in the Moluccas, wear bracelets made of shells or porcelain. The Caffres put large feathers in their hair, and brass or ivory rings upon their arms. The Hottentots adorn themselves with broken mirrors, brass rings, and jingling shells. The head of the New Zealander, which appears above his thatch dress, is powdered and decorated with bones, buttons, and beads.

All classes of the Madagassy wear bracelets, chains, rings, and ornaments for the hair and forehead. Large rings of cotton or hemp covered with small beads in various patterns, are worn by both sexes on the ankles, arms, and wrists. The Cossack female wears a mitre adorned with flowers or pearls. The humming-bird is worn by Indian ladies as an ear pendant; and the females of Tartary ornament their head-dress with the necks of herons disposed like horns. The hair of the Hindoo female is adorned with floral wreaths; her ears, with pearls; her bosom, with precious stones.

VIII. Germany contains twenty-four universities,

and, in the northern states of the empire, useful learning is diffused among all classes. The fine arts are cultivated in Tuscany at the expense of primary education. Millions are expended in building chapels, and educating promising artists. France has lyceums for languages, history, rhetoric, logic, and the natural and mathematical sciences. Amidst the convulsions which have swept over her in successive tornadoes, her literary institutions struck deep their roots in the mental soil. Her educational system which commenced under the republic, flourished under the emperor, after the restoration, and after the late revolution.

CHAPTER VIII.

GENIUS.

THE variety in human genius suits different men for different pursuits, and dispels dull monotony from human affairs. A peculiar genius appears long before man casts off his parental dependency; and society, through this diversity of genius in its members, glows like a variegated landscape. Its respective members resemble towering cedars, sturdy oaks, creeping ivy, verdant shrubbery, graceful pinks, delicate roses, splendid palaces, humble cottages, glowing rubies, and sparkling emeralds, grouped into elegant symmetry. Society, as illustrated by an apostle, has, like the human body, suitable members to perform the several offices to the general ornament and happiness. The Deity, by forming men into different moulds, and by placing them in different circumstances, so distributes taste and genius over the varied fields of philosophy and art, that every sequestered walk may be brought under appropriate culture.

Man has a more comprehensive vision, superior enterprise, and endowments for command; and woman, in a tributary relation, is his assistant, his comforter, and his companion, to cheer him in his arduous duties. As the dew produces the most

fertility in the shade, so woman, in the shade of domestic retirement, sheds around her path the richest and most permanent blessings. If she does not conceive so grandly, she elaborates with more exquisite delicacy. She chooses sedentary amusements and unlaborious occupations; and while revolving in her proper orbit, she sheds around a mild lustre which pleases by its regularity, beauty, and usefulness.

The Negro has a physical structure for enduring a tropical sun, for rendering a Southern plantation a delightful residence. His skin is guarded against blistering, his eye is protected by an appropriate membrane, and his brain is secured by a suitable cranium with a woolly covering. An African performed as much severe labor in the Mexican mines as two or three Indians. The Virginians and Kentuckians have always proved stronger than the American savages. Strength depends much upon nutritious food and active occupation; and the industrious portions of a civilized community, are more vigorous than those miserable savages that are so often depressed by the severest privations. The Arabs, in large hordes, visit, at a certain season, the commercial cities to procure necessary commodities, then plunge, for the remainder of the year, into the trackless desert. The Anglo-Saxons smile at the ice of wintry seas, or at the burning showers of equatorial sands.

Some races have acute senses, which fit them for peculiar duties. The New Hollander hears very remote sounds, and sees objects at an almost incredible distance. The New Zealander hears distinctly

the sound of a very remote gun, and readily distinguishes a strange sail on distant waters. The Hottentot observes a deer at a great distance, hears the humming of a remote insect, and singles out a particular foot-print among a thousand. "The Calmucks have a fine nose, a good ear, and a good eye." They smell a distant fire, hear the trampling of remote horses, and pursue game by the track for miles over deserts. Smell occurs among savages in a far higher degree of activity than among civilized nations, whose nerves are blunted by the use of highly-seasoned food, by exposure to strong odors or intricate combinations.

The superiority of the sensorial organs is confirmed by exercise, and is very serviceable in civilized society. Some detect inequalities in surfaces which feel smooth to others; and smell acquires, with some, a delicacy of discernment which intimates, with exactness, the approach of many bodies. Hearing, in some, has a fineness of discrimination which tells the direction and distance of sounds, and measures differences of tone which are insensible to blunter ears. Such an endowment, with proper culture, charms society with exquisite music. Mathematical investigations are facilitated by visual symbols, and perseverance accomplishes noble results under very formidable difficulties. Poetry and music, having their materials chiefly in the imagination and affections, do not so much depend on visual symbols.

The dark races, who possess the acutest senses, display insensibility to moral beauty, manly virtue, and elevated sentiment. They are always ready for sensual indulgence, and satisfaction is depicted on their

very countenance. Their affection for a master is so ardent, that they will execute the most hazardous office to demonstrate their zeal and attachment. Of some races inferiority seems to be the natural destiny. The Abyssinians are void of cultivated science, and sunk into savage degradation; and, unless Egypt and Barbary be exceptions, there is no civilized nation in Africa. The flight of centuries seems to extinguish all hopes of future amelioration, and to give African destiny "a gloom as deep as that which" is "spread over their complexion." Tartary, which possesses meandering rivers, and extensive plains blooming in perennial sweetness, is not enriched with handsome villages, flourishing cities, and literary institutions.

The Caucasian variety excels in intellectual discernment, in the nobler feelings of humanity, in the accomplishment of the grandest undertakings. Europeans, in every age, have exhibited a strong tendency to high intellectual development and culture. Cities were early founded, the arts were encouraged, and literature was cultivated even in tumultuary intervals. The Etruscans, before the foundation of Rome, had established the arts in Italy. Under the Greek and Roman empires, the human mind attained a very high eminence in literature and the plastic arts. After the irruption of the Northern tribes, the sun of science emerged from Gothic darkness, and threw out its bright beams upon the world. Their elasticity of mind, incapable of permanent suppression, gathered strength in depression to burst the fetters which opposed their intellectual expansion. Oppressive laws, neglected education, and religious bigotry,

counteract, for a season, the noblest gifts of nature, and plunge into degradation the nations which are capable of the highest culture, and the most splendid achievements. Intellect, as soon as the external pressure is removed, stands forth in its original grandeur, and comes up to the type assigned by nature.

The most prominent characteristic of a people continues like the peculiarities of their soil. Some uncivilized tribes, from long and acute observation, can cross a forest or plain two hundred miles without any material deviation, and point to the place of the sun when it is intercepted by clouds or fogs. Such tribes, however, notwithstanding these extraordinary intellectual qualities, sicken and die under the shade of highly civilized life. Ever since the Turks have had possession of the classic land, they have exerted a wanton hostility to taste, by demolishing temples, mutilating statues, and defacing elegant sculptures. Some of the finest statues, supposed to be the work of Phidias, were burned into lime. The Asiatics early arrived at a certain stage in the arts, and have never passed a certain development. China remains a stereotype page, an enduring monument. The Athenians, though depressed by haughty tyrants, still possess that quickness of apprehension, vivacity of temper, and urbanity of manners, which distinguished their illustrious ancestors.

The Greeks, beyond all other nations of antiquity, enjoyed the happiest advantages for the promotion of elegant literature. They were encircled with a soft, balmy atmosphere, sweetly tempered with cooling sea

breezes, and blessed with a fertile, varied, and beautiful landscape. The mildness of their climate favored the finest development of the physical and intellectual powers, uniting a vigorous constitution with a lively imagination and profound sensibility. The serenity of the skies, the smooth and glassy sea which surrounded and indented the coast, harmonized the ruder passions, and called forth the finest and noblest feelings. The nature of their country, its coasts formed into gulfs and peninsulas, afforded peculiar facilities for social intercourse. Foreign commerce, and the freedom of their government, contributed favorable influences.

Amazement at new scenes fed the imagination with constant fancies, and rendered the conversation of every-day life poetic. They soon became enamored of the graceful and beautiful, and nature led them to music and poetry. Favoring influences excited every faculty to energetic exercise, awakened the choicest spirit of poesy, and developed the delicate germ to its most elegant maturity. Freshness and raciness of thought and expression, were accompanied with graceful simplicity and beautiful transparency. Language was ready to receive its symmetrical form from the magic touch of poetry, and its flexibility lent its aid readily to poetic requirements. The age of the imagination had not yet been mellowed by the critical faculty. The mind sat in front of the stage, not behind the scenes. It was under the illusion of the spectacle, and had not watched "the movements of the ropes and pulleys." The judgment ripened while the imagination began to lose its sparkling brillian-

cy; and when imagination was verging towards decrepitude, taste was rising to maturity. The imagination, though flagging, now employed better instruments; and poetry, for a while, improved while the poetic faculty was declining.

The Greek language, says Coleridge, had an "infinite flexibility," an "indefatigable strength, with the complication and the distinctness of nature itself." "Words like pictures," "like the gossamer film of the summer," imparted "at once the variety and picturesqueness of Homer, the gloom and the intensity of Æschylus." The language was "not compressed to the closest by Thucydides, not fathomed to the bottom by Plato, not sounding with all its thunders, nor lit up with all its ardors under the Promethean touch of Demosthenes!" From Athenian genius have sprung the noblest creations of the human intellect, the brilliant fancy, the withering fire, the plastic imagination, the lively humor, the sparkling wit, the majestic comprehension, the varied excellence, of succeeding writers. Its spirit has consoled the votaries of liberty, the lonely lamp, the restless bed, the turbulent tribune, the ignominious scaffold.

The same powers of mind are displayed in the poetry of the Greeks as in their statues. Both are exquisite imitations of nature; the one in marble, the other in words. The physical organization of the Greeks was susceptible of external impressions, and in harmony with external nature. When every thing is perceived easily, every thing is perceived in harmony and proportion. Their literature, like their

temples, has inimitable symmetry, perfect harmony of proportion, and noble simplicity. They were encamped in cities, and each morticed to his place in society. As each had his station in the political machine, he could only subsist by strict subordination and regularity. Intensity of observation and energy of purpose became necessary characteristics, and communicated themselves to art and language. The tragic poets were as severe in poetry as in discipline.

The plastic arts attained their highest perfection in ancient Greece. The delightfulness of the climate, the elegance of the human figure, the views of beautiful scenery, the rewards bestowed upon artists, the application of the arts, the flourishing condition of polite literature, contributed to form Grecian genius into the finest mould. The human body expanded into symmetrical delicacy, and appeared in its most attractive charms. So anxious were they to improve personal beauty, that of the four wishes of Simonides the second was to have a handsome figure. As statues were decreed to the victors in the public games, the artists had models pre-eminent in strength and agility. Chrysippus and Cleanthus distinguished themselves in the public games before they were known as philosophers. Pythagoras carried off the prize at Elis, and Plato appeared as a wrestler at the Isthmean and Pythian games. The sculptor was so highly esteemed, as to have his statue placed beside those of the most renowned heroes. The excellence of art was estimated by the greatest sages in the general assembly, and the able sculptor was con-

fident of obtaining immortality. The figures are harmonized in a magic light, and embodied in the ideal loveliness of our most impassioned dreams. Every deep emotion of the heart, every wandering frenzy of the imagination, was realized in some bewitching form.

The ages of chivalry and romance have stamped their character on genius and literature—a character diverse from classic symmetry and purity. The Romantic style resembles the Gothic architecture with its huge columns, flying buttresses, aerial pinnacles, curious tracery, budding stones, fretted vaults, interlacing lights, religious shadows, obscure niches, and solemn splendor. In the dissolution of society, each person was thrown back into the domestic circle, or left to pursue his solitary way to fame and fortune. This age gave birth to all that was constant in attachment, adventurous in action, and extravagant in invention. The imagination was lost amidst deserts, or suddenly transported to stately palaces echoing with dance and song. Every thing became confused and vague; and the Romantic style, in its earlier ages, presents its wild, rich, obscure images for modern use.

Firmness is a prominent trait in the English, who advance with determination to execute their various purposes. The French excel in the arts of an elegant imagination, in the exact sciences, in learning and general intellectual cultivation. The manufacture of fine porcelain, rich silks, and ornamental work in ivory, is congenial to the Asiatics. The Italians excel in music and the plastic arts; the Germans,

in learned criticism, statistics, book-making, and mining. The Americans deem it a curse to repose, and toil from morning to night, as if to prevent death by apathy. They seem to have a steam engine in their very constitution, urging to incessant and restless activity in building up cities, public works, and flourishing states. Descendants of a wandering race, they exhibit its hereditary propensity; and through this energy of the nomadic mind, mankind have reached an unprecedented enlightenment. The huge pyramids of Egypt characterize the adhesive races; the peculiarity of the Nomades, in their highest cultivation, is exhibited in railroads, steamships, and magnetic telegraphs.

A general tissue of the feelings and propensities, gives a sparkling vivacity, a refined taste, a phlegmatic industry, or an enterprising spirit. An outline of a classification of the temperaments, was attempted by the Greek physiologists. The nervous temperament imparts an acute sensibility to external impressions. The sanguine temperament has a perfection of the muscular masses, and can scarcely, with any intellectual faculties, conduct to philosophic fame. The lymphatic constitution is plodding, and not formed to disturb the earth with negotiations and conquests. The bilious habit exhibits abruptness, impetuosity, violence of passion, hardihood in conception, steadiness and inflexibility in pursuit, and indefatigable perseverance in execution. These temperaments are blended with one another in various combinations, exhibiting an almost endless variety. The propensities are combined with the proportions of the men-

tal faculties, so that individuals are as distinguishable by a peculiarity of intellect as by the features of the face.

One feels a love for fame; another is deaf to censure, and callous to applause. One lays up riches which he does not stop to enjoy; another scatters with wasteful prodigality. One fathoms the profundities of science; another scarcely gropes through the commonest occurrences. One enjoys a perceptible pleasure from the contemplation of forms and colors; another sees no beauty except in utility or fitness for producing riches or fame. One soars aloft in a towering imagination; another, even in the delirium of a fever, never rises to the regions of a brilliant fancy. One courts danger; another shrinks from hazardous enterprises and pursuits. One seeks plodding employments; another converts relaxation into active occupations.

Taste consists in the power of judging; genius, in the power of executing—and both are necessary for many pursuits. Genius sometimes executes with vigor, while taste has not attained its full maturity; and the same man scarcely ever executes with animation, and, at the same time, attends to minor and refined graces. "Men of splendid talents," says Bulwer, "are generally too quick, too volatile, too adventurous, and too unstable to be much relied on; whereas, men of common ability, in a regular plodding routine of business, act with more regularity and certainty. Men of the best intellectual ability are apt to strike off suddenly, like the tangent of a circle, and cannot be brought into their orbits by attraction or gravity. They often act

with such eccentricity as to be lost in the vortex of their own reveries." Their talent, however, "like the fire and the flint," is "converted, by solid thinking men, to very salutary and noble purposes." Philosophers of brilliant powers are sometimes so deficient in invention, as to be unable to apply their own useful discoveries.

A true genius combines imagination with intuitive judgment. Genius is displayed in the utterance of harmonious sounds, in the rapid solution of mathematical questions, in the delicate mixing of beautiful colors. One combines commercial conceptions with speed and vivacity; another, with difficulty and dullness. Some agriculturists seem to have little more imagination than the clods they cleave; others seem to penetrate the nice order of vegetation, and never suffer a season to roll over them without wringing from it some important secret. In manufacturing towns some discover an acuteness of intelligence, a rapidity of combination, over their fellow-artisans.

Some men have a constructive propensity which is not limited to particular materials or fashions; and, favored with genius, they improve huts, erect commodious habitations, construct canoes, build ships, or execute elegant statuary. A susceptibility to perceive, a sensibility to enjoy the beautiful, are necessary to form a successful artist. The art of designing, which is employed in representing forms and actions, is the common foundation of the plastic arts. Perspicuity, appropriateness, loveliness, and accuracy, are essential traits in allegoric pieces. As the plastic arts represent "the characters and passions of the human soul,"

"the dexterity of the hand is of little avail, unless it is animated by fancy and guided by the most correct taste and observation." So sparing is Nature of high artistic genius, that Alexander the Great, in an age of celebrated artists, allowed Apelles alone to paint his likeness, Lysippus alone to carve his statue, and Pyrgoteles alone to sketch his miniature on the precious stone.

Some philosophers delight to investigate the properties found in the mineral kingdom; others, to develop and improve the rich fruits and floral beauties which embellish the earth in varied prodigality. Poets have sung of agriculture, theologians have extolled its virtues, and statesmen have returned to pass the evening of life in its calm and peaceful labors. It adds to civilized refinements, renders home attractive, invigorates the mind, chastens the affections, fills the mind with grateful emotions, and imparts to a northern climate the gorgeousness of an Asiatic summer. Some, on entering the gates of the animal kingdom, find a combination of allurements which fascinate them with a magic captivity. They behold the nice spontaneity which approximates to our own nature, and run over with avidity the vast volume of tastes, customs, manners, propensities, passions, and instincts.

Some persons derive rules of taste from elegant writers, with a facility and rapidity which people of inferior endowments cannot comprehend. The literati, the ornaments of human nature, display beauty spots and ornamental graces drawn from the lap of classic elegance and pastoral simplicity. Some cannot live in the atmosphere of common life, but seek a higher region

for feeling to luxuriate in undisturbed enjoyments. They convert the molten breath of sentiment into glittering but graceful conceits, and dwell in the empire of the imagination, which is wider and more prolific than that of experience. Some writers, like the naked aspect of a wood after conflagration, exhibit a dreary darkness without life or verdure. Some, again, have the happy genius of raising the meanest, adorning the most barren, and diversifying the most familiar topics. Their coloring is soft and splendid, their fancy rich and copious, their expression easy and forcible, their versification flowing and harmonious.

Some minds, with quick perceptions, take the direction of shifting circumstances, and manifest a careless and vivacious disposition. A particular consideration is not distinctly held up to the mental vision; and their track, like the lines in a navigator's chart, is only remarkable for continuousness. This disposition indisposes them to settle into any regular plan of life; or, if a plan be imposed by circumstances, they want method and continuity in business and intercourse. Such a superficial intellect is unfitted for forming consecutive measures, comprehensive dependencies, and tracing out the chain of actual causations. Their speculations, like light streaming through the windows of an ancient cathedral, are modified by the hues of the pictured medium through which they pass. A luminous principle, like the entombed lamps of the Rosicrucians, gives them no permanent advantage. They view nature in dispersed fragments or in unperspicuous aspects, which, like the shapes of moonlight or Ossian's ghost, only exhibit dim forms of uncircumscribed

shades. They fill up a niche in human life, while minds which combine minuteness of detail with comprehensive views, are suited for public employments.

Many persons are prone to advance an analogy for an argument, to infer that the present case is no exception to Nature's ordinary arrangements. Without reducing their principles to primary elements, they abound in strange illusions and impenetrable obscurity. As they perceive resemblances only, a difference in a single point destroys their supposed analogy. Their analogies often lead them to erroneous conclusions, and their fancies, like the mirage of Egyptian sands, impose upon their credulous understandings. The charm of popular speakers consists in perspicuity of statement and copiousness of illustration; and many display fluency of elocution and quickness of apprehension, without being either impressive or profound.

Minds possessing great individuality are often deficient in retention and comprehensiveness. Actions, like shadows on a mirror, are too fleeting for their appropriate examination. Not retaining primary perceptions, they must necessarily be deficient in classification, comprehension, and concentrativeness. Such minds, like a wind instrument of music, lose the note as soon as the original impulse ceases. In some minds a variety of emotions becomes intermixed, every sentiment casts its own peculiar light, and the reflection of single rays brings the faculties into a fiercer glow. Various conceptions give a permanent tinge to the passions, and render them inaccessible to other complexions. Such a mind, like a star which dwells apart, has little sympathy with human feelings and frailties. Not

catching the hues of surrounding nature, it irradiates a narrow shrine, like a kindled furnace which throws out its intense glare and gloomy grandeur.

The sciences which depend upon numerous individual facts, such as botany and physiology, have many eminent professors whose reflective faculties do not rise above mediocrity. Endowed with observational faculties, they inquire of nature for information, and do not seek to arrive at new truths by reasoning. They detect the minutest differences, and make the most brilliant discoveries. The inductive philosophy is successfully promoted by a class of minds formerly excluded from scientific pursuits. Possessing a store of individual facts, they find much difficulty in reducing them into precise and specific forms. Taking no comprehensive survey, they dissect that which is immediately before them, and often strike upon a palpable absurdity, a contradiction to general principles or more extensive analogies.

A promptitude to observe, a facility to perceive resemblances, a judgment to arrange facts into systems, constitute a philosophic genius. He possesses an aptitude for observing the commonest occurrences, for treasuring up the lessons of experience, for assigning every fact to its proper place, for collecting all his conceptions into a strong mental picture. He compares the most opposite actions, perceives unsuspected analogies, and draws instructive conclusions. His primary impressions are clear and vivid, his memory is precise and retentive, and his reasonings are conducted in a connected series. He displays sagacity in admitting facts, acuteness in form-

ing classifications, and dexterity in arranging his mental resources. His conceptions are retained for rigid examination, his arguments are necessary consequences, and his conclusions are sure deductions from his premises. He places facts clearly before the mind, passes gracefully to connected topics, and centres the parts of a long series into a glowing unity.

Vivacity, richness, and unity, are also necessary accomplishments for poets and historians. The lines of the picture must be distinctly drawn, the plan completely filled up with incidents, and the field enlarged with comprehensive views. The unity of Virgil is the establishment of Æneas in Italy; that of Tasso, the recovery of Jerusalem from the infidels; and that of Milton, the expulsion of man from paradise. The progressive enlargement of the Roman empire, furnishes unity to Livy's history. Polybius remarks that the "action is distinct in its beginning, determinate in its duration, and clear in its final accomplishment." "The Decline and Fall" of the same empire, is the action of Gibbon's history; and the vividness of that action constitutes the charm of his splendid tragedy. The decay of public spirit, the descriptions of barbarous manners, the hostile movements on the boundary, pave the way for the final catastrophe.

An ardor for particular pursuits acquires eminence under decided disadvantages, and entirely removes minor physical defects. Individuals, deprived of the use of their hands, have painted and written with their toes. Rugendas, who is celebrated for his

battle pieces, after his right hand became unserviceable, painted with his left hand with the completest success. Beaumont, a French advocate, finding the feebleness of his voice incurable, devoted himself to writing memorials for his clients, with so much assiduity as to establish a most brilliant reputation. Demosthenes, the unrivaled Athenian orator, cured an indistinct articulation by placing pebbles under his tongue, and strengthened a feeble voice by declaiming near the noisy waves.

Blindness, which closes up an important avenue, has many examples of distinguished eminence in intellectual pursuits. Diodotus, after losing his sight, still more assiduously taught geometry and Grecian literature; and Didymus, who was early afflicted with blindness, distinguished himself in the seven departments which then constituted the whole field of human learning. Milton, whose noble intellect supported itself under accumulated pressure, wrote, after his calamity of blindness, poetical and philological works of extraordinary magnitude. Salinas, who was born blind, distinguished himself in science and literature, and became a professor in the University of Salamanca. Blind Harry, the Scotch minstrel, recited verses at the feasts of the nobilty, and published a work which is still read in a modernized form. Scappinelli, who was blind from his birth, held a professor's chair successively at Bologna, Modena, and Pisa; and his works, both in Italian and Latin, are distinguished for learning and elegance. Stanley, who lost his sight in his second year, stood, for many years, at the head of the practitioners of sacred music in England; and

Huber of Geneva, after losing his sight, wrote an ingenious and original work on the natural history of insects. A French lady, who lost her sight in her second year, was an elegant writer; and Nicasius, becoming blind at the same age, taught canon and civil law in the University of Cologne, and possessed extraordinary erudition. Nicholas Bacon, after his blindness, prosecuted legal studies with eminent success in Brabant; and Blacklock, who became blind in six months, raised himself from abject poverty, embraced every opportunity for improvement, issued, poetical publications, and obtained a respectable standing among literary characters.

One blind sculptor made statues in clay; another in marble, with great taste and accuracy. An English lady, of liberal education and gay connections, being precipitated into blindness and poverty, executed needle-work, preserved personal neatness, and published literary performances. Metcalf, who became blind before he knew the effects of light, acted as a guide on intricate roads during the night, and as a surveyor of highways in difficult and mountainous regions. Count Pagan, during twenty years of total blindness, devoted himself to mathematics, and gave to the world various publications. Moyes, who had scarcely any visual recollections, distinguished himself in literature and mechanics, delivered lectures on chemistry and philosophy, and contrived a new system of palpable arithmetic. Saunderson, though losing his sight at one year of age, distinguished himself in ancient literature, made calculations with incredible facility, performed algebraic

operations solely from memory, delivered prelections on Newton's Optics, and devoted himself almost entirely to his pupils. Euler, who calculated himself blind, exhibits the wonderful triumphs of mental energy over opposing circumstances. His algebra, a work translated into every language of Europe, is, though dictated to an amanuensis, composed with admirable clearness and simplicity. His works enrich the Academies of Berlin, Petersburg, and Paris; the mere catalogue of which extends to fifty printed pages.

"Numerous and affecting examples," says Chancellor Kent, "prove that persons deprived of the faculty of hearing," "possess sharp and strong intellects, susceptible of extensive acquirements in morals and science." Navarete, who lost his hearing at two years of age, displayed from infancy the strongest passion for drawing. He covered the walls of his apartments with pictures, and possessed considerable learning. An English lady, who was both deaf and blind, held social intercourse by palpable signs, a species of writing which restored a being to society from a seclusion almost as complete as the grave.

William Davy, an English clergyman, gave early indications of mechanic genius, and diversified his classic learning with ingenious mechanism. Renkin, a carpenter of Liege, raised the waters of the Seine to the gardens of Versailles; and Zabaglia, a common carpenter, executed many mechanical contrivances distinguished for simplicity and elegance. Ferricino, a self-mechanician, constructed a clock at Venice, erect-

ed a bridge over the Bretna, and made machines for various purposes. The untutored genius of Brindley grasped the laws of Nature, solved complicated problems, made beneficial applications, executed novel machinery, made economical simplifications, brought water through rocks to drain mines, carried a canal over a navigable river, cut canals through mountains, made the elements subservient to his designs, and astonished the world by his daring achievements. Peter the Great viewed the arts of civilized life with an intoxication of surprise, and esteemed an English admiral happier than the czar of Muscovy. He descended from his throne to labor in foreign dockyards, ropewalks, iron-foundries, paper-mills, and watchmaker's shops. In his leisure moments he took lessons in mathematics, navigation, anatomy, languages, and the elegant arts. On his return to Russia, he entered into familiar conversation with the peasantry concerning their furniture and farming implements. He taught his people navigation, agriculture, and manufactures, founded schools, academies, colleges, and museums, and introduced a flourishing civilization into a barbarous country.

Of Polygnotus of Thasos, Aristotle remarks that "color in his hand was the organ of expression;" and Apollodorus displayed the "tones of color, light and shade." Zeuxis painted fruit which beguiled birds; but Parrhasius painted a curtain which deceived Zeuxis. Apelles, in his contest with Protogenes of Rhodes, drew lines with different colors, one within the other—an exploit astonishing to artists. Angelo, "the salt of art," exhibits magnificence of

conception and execution, with beauty only in subserviency to grandeur. In his epic performances, like Homer's poetry, the simplicity of the whole unites magnificence of plan with endless variety in the subordinate parts. The sublime circle of the Sistine chapel, exhibits "the origin, the progress, and the final dispensations of the Theocracy." "He personifies motion in the cartoons of Pisa," embodies "sentiment on the monument of Lorenzo," unravels "the features of meditation in the prophets and sybils of the chapel of Sextus, and traces every attribute that varies the human body," "every passion which sways the human heart," in "The Last Judgment." His Venus only wants "the last breath of inspiration to cause the marble mass to start into life."

Raphael, who transmits the features of nature like a lucid glass, pleases the beholder with softness and beauty. Delicacy and affection, refinement and sentiment, render his style "winning and delusive." The art of Porta gave gradation to color, form and masses to drapery, and caused figures to stand out in perfect relief from the canvas. Caravaggi, recommended his forms "by ideal light and shade;" and Rembrandt, by "a kind of magic," "placed every tone in its proper place," and preserved "the flower and freshness of the colors." Giotto, to attest his ability, "drew a perfect circle" "with one stroke." Leonardo, possessing all the elements of genius, favored by education and circumstances, supped with peasants, provoked their laughter, studied their rustic expressions, executed splendid paintings, and expired in the embrace of a king.

Berruguette enriched Saragossa, Valladolid, Salamanca, and Madrid with paintings; and Rubens, who was remarkable for his depth of coloring, received honorable attentions from the sovereigns of England, Spain, and other countries. In his infancy, Titian colored a print in a masterly manner with the juice of flowers, and the beholder often passes uncovered by his portrait of the Roman pontiff. From the lowly toil of a potter, Correggio conceived himself a painter, struggled long with poverty and neglect, and gave to his pictures a magic harmony which affects us with "the soft emotions of a delicious dream."

Torrigiano, a Florentine, enriched the cities of Andalusia with sculptures; and Canova, a Venetian, from his early study of antiques, succeeded in endowing his statues with classic elegance. Without previous instruction, Flaxman began to practise sculpture as a profession, executed the monument to Lord Mansfield in Westminster Abbey, and sculptured from Homer's description the shield of Achilles, representing astric, rural, and urban scenery, with more than one hundred human figures. Thorwaldsen called the time of his entrance into Rome his birthday; and Maria Louisa, daughter of Louis Philippe, was, at the time of her death, executing a statue for public exhibition.

Perrier, a poor boy at Lyons, went on foot to Rome, and, after studying its monuments of genius, obtained a high reputation among artists at Paris. Lorraine, an apprentice to a pastry-cook, performed the lowest offices to painters in Rome, and rose to a rare eminence. Rosa, whose genius was nourished in sorrows,

supported his mother from the sale of his pictures, studied the arts of Rome with such intensity as to bring on a fever, and considered his consequent removal from that celebrated city as an exile. Ribera, after struggling with indigence, found himself in the palace of a cardinal; but, finding his attention relaxed by luxury, he returned to laborious poverty, verifying a beautiful fiction of Xenophon, the choice of Hercules.

Benjamin West, at the age of seven years, delineated on paper the features of an infant child sleeping in its cradle. He took hair from a favorite cat to make pencils, and colored his pictures with indigo and red and yellow ochres. Obtaining paints and pencils, he was so fearful that his treasure was only a dream, that he put out his hand to feel them at night. Many incidents indicate a wonderful precocity; and some inventive touches of art were not excelled in his subsequent essays. He commenced portrait painting at fifteen, and soon after drew the death of Socrates, which induced him to study human anatomy. At twenty-one he embarked for Italy, and after seven years, went to England. His first painting in that country, the story of Pylades and Orestes, established his fame. The king appreciating his genius, became his munificent patron for thirty years, during which time he painted many historical and allegorical pictures from sacred and profane history.

Jarvis Spencer, a menial servant, became a celebrated miniature painter; Joseph Highmore, a solicitor's apprentice, enjoyed a high reputation for historical

pieces; Richard Wright, a ship painter, is much celebrated for his sea pieces; and Sawry Gilpin, a common painter, is distinguished for the faithful delineation of animals painted in fanciful groups. Gainesborough, while a mere boy, employed himself all day in drawing the objects presented in the woods or pasture fields; and his deep sensibility for natural beauty, gives his landscapes a perfect fidelity and an inexpressible charm. James Barry, a ship boy, covered the deck with sketches, and spent his scanty means in purchasing books and candles. A picture which he placed in Dublin, excited so much admiration that the young ascetic became the favorite of the gayest circles in his native metropolis. He soon withdrew from society, passed a life of incessant toil, wore the coarsest clothes, lived upon the humblest fare, and engraved for bread while he was finishing his magnificent paintings. Thomas Lawrence, the first portrait painter of his age, exhibited remarkable precocity. He attracted customers to his father's inn, and, notwithstanding his illiteracy, became painter to the Dilettanti Society, and painted a few moments before he expired.

Some of the ancient philosophers parted with their inheritances, to preclude interruptions in their favorite pursuits. The master of Socrates bid adieu to his possessions in Ionia, repaired to Athens, and gave lessons for support after his estate was gone. Alfred of England, who measured his time by the burning of candles, contrived a horn lamp; Haroun al Raschid, an excellent poet, was distinguished in various learning; and Charlemagne, who gave his leisure to study,

executed some literary performances. Marcus Aurelius attended philosophic lectures, and attempted to restore Athens to the eminence of a literary metropolis. Bayle had a strong sympathy for a secluded life; Democritus left rich treasure at home to go into India for information. Spain owes her earliest national history, her translation of the Scriptures, the restoration of her principal university, the introduction of her vernacular tongue in public proceedings, and her celebrated astronomical tables, to Alphonso the Tenth. Alphery, who had a title to the throne of Russia, lived a pious life in England. William Drummond was so well satisfied with philosophy and the muses, that he refrained from mingling in political agitations and anxieties. Napier, the inventor of logarithms, had an ampler reward than can be attained in political hazards and vexations.

Bacon made an exact sounding of the human capacity, and what was wanting to advance the sciences to their full accomplishment. His observations take a wide range, a fine profundity, a bold comprehension. His induction is wonderful for learning and vivacity, for curiosity and dignity. He had great sagacity of observation, solidity of judgment, and scope of fancy. He surveyed the road of induction, called public attention to that inexhaustible source of true philosophy, and removed the cloud which had previously concealed the only true route to science. As the sun first illuminates the hills, so the rays of discovery first darted upon his lofty mind. He looked around from his lonely elevation upon future prospects; and, where the multitude saw a sterile desert or deceitful mirage,

he extended his vision to fertilizing rivers and diversified landscapes. Some minds, like an atlas, give the distances of cities; the intellect of Bacon, like a globe, sketched out the whole earth. When he descended to particulars, he became fantastic and visionary. He was grand in reflection, not in construction. Bacon, like Moses, leads his followers to the verge of science; and other philosophers, like Joshua, usher them into the promised land.

Tournefort, while very young, displayed an enthusiastic fondness for botany. Though designed for a profession, he was at length permitted to indulge, without restraint, his favorite pursuit. He ranged over the Alps and Pyrenees, collecting plants, often periling his life from banditti, precipices, and glaciers. Linnæus, who was designed for the sacred office, left his study to gather flowers. His father attributing this taste to frivolity of mind, was about to put him to mechanical employments; but, through the solicitation of friends, he was placed in a situation favorable to his peculiar talent. He was ennobled for his success, and called the Northern Light. Michael Adanson abandoned divinity for botany, and explored the banks of the Senegal, in the belief that the unhealthiness of the climate would, for a long time, prevent its visitation by naturalists. John Bartram, a farmer of Pennsylvania, cultivated botany with such success as to be pronounced by Linnæus, "the greatest natural botanist in the world." In the intervals of agricultural labor, he made excursions to Canada herborizing with intense delight, and, at the age of

seventy, performed a journey of botanic exploration to Florida.

Humphrey Davy, during his solitary rambles, sometimes sighed aloud for fame. The rocky coast of Cornwall and the sea-weed cast ashore, were the materials which afforded food for his inquisitive mind; and, being placed with an apothecary, he forgot his professional avocations, rambled the country for minerals, and experimented in the garret, sometimes to the danger of the whole establishment. To ascertain the nature of the air contained in the bladders of sea-weed, he took gallipots from the shop, pans from the kitchen, and converted an elegant surgical instrument into an air-pump. His success as an experimentalist, was partly attributable to his early necessities. The scientific world was astonished at his application of galvanic energy to composition and decomposition, at his inference that electricity was identical with chemical affinity. The French Institute, in forgetfulness of national jealousy, awarded to him the first prize. He found the metallic bases of the alkalies, and exhibited their curious properties. His safety lamp, for lighting miners in the midst of explosive mixtures, was constructed upon the principles of flame; and his invention for protecting the copper sheathing of ships, resulted from his electro-chemical experiments. His writings exhibit the elegant scholar as well as the accomplished philosopher.

Scheele, an apprentice to an apothecary, secretly prosecuted chemical studies at night, experimented in the garret, and alarmed the house with detonations. He was at last discharged, for no menaces could deter

him from such dangerous pursuits. Lavoisier, when brought to the guillotine, requested time to finish some important experiments in agricultural chemistry. Henry Cavendish dedicated his life to philosophy, with a zeal which no change of fortune could suppress. He watched his experiments with the acutest observation, and obtained results which had baffled less careful experimentalists. His discovery of the composition of water, his contributions to electricity, his determinations in pneumatic chemistry, rank among the most brilliant achievements. His writings, which embrace a period of fifty years, are marked by accuracy, originality, and elegance. He established an extensive library, which was accessible to all scientific inquirers ; and Biot, a French writer, says that Cavendish was the richest of the learned, and the most learned of the rich.

The genius of Rumford, whose fortune was lost during his infancy, soon prompted to philosophic pursuits. His splendid discoveries in the principles of light and heat, were successfully applied to advance domestic economy and relieve suffering humanity. His lamp threw out a mass of flame, and his arrangement of colors produced the most agreeable effects. The principles of heat were employed in the preparation of clothing, in the construction of cooking apparatus, in the erection of furnaces for warming large establishments. Smoke was not suffered to quit his apartment till it was almost cold. He determined the most nutritive substances, and the best mode of their preparation for use.

The philosophic Franklin rose from the deepest

obscurity to the highest distinction, and, without instructors, enriched himself with science and literature. Electricity was beginning to attract the attention of the ablest philosophers; and his acute genius suggested a beautiful generalization, which diffused order into unintelligible contradictions. As electricity and lightning had many known resemblances, he proceeded to test their identity by actual experiment. He brought down lightning into his house, experimented with it at his leisure, and guarded buildings from its destructive effects. Towards the close of a long life, the patriot is seen casting a splendor over the philosopher. The once tallow-chandler is seen standing before kings, making treaties for mighty nations.

The propitious lot of Boyle furnished facilities for passing life in the most various and excursive studies. Science was a profession from which no temptation could seduce his mind, and he met his associates at an apothecary shop to obtain drugs for experiments. His whole life was spent in experimenting, in collecting facts, in constant correspondence, in improving instruments, in studying natural history. Pascal, by tracing figures on the floor, demonstrated geometrical propositions; and Rittenhouse drew diagrams on his plow, to study at his rural occupations. Ferguson observed the places of the stars by a thread with beads; and Brahe, from measuring angular distances with a pair of compasses, proceeded to erect an observatory with appropriate instruments. Christopher Arnold, a peasant near Leipsic, erected an observatory at his dwelling-house, discovered many

phenomena sooner than other astronomers, and obtained great celebrity from his observation of a transit of Mercury.

Newton lodged at the house of an apothecary, and devoted himself to scientific contrivances as auxiliary to his favorite studies. With characteristic modesty he compares himself to a "boy playing on the seashore," finding sometimes "a prettier shell than ordinary, while the great ocean of truth lay all undiscovered before" him. Kepler, whose life was spent in poverty, declared that he would not exchange the authorship of his writings for the whole duchy of Saxony. Lagrange, the illustrious mathematician, made his way from poverty to fame and fortune. Shaeffer, the naturalist, lived on a scanty fare at the university, and without fire during a rigorous winter. Samuel Parkes first appears as an apprentice to a grocer, then in business as a soap-boiler, then as a manufacturer of chemical preparations, then as a popular writer on science. Though engaged in an extensive manufactory, he found time to write books, and to contribute to periodical literature.

Hesiod, though defrauded of his patrimony, obtained a sufficiency by his writings for himself and for charity; and Pindar, of low origin, was courted by princes, and died in a public theatre. Plautus, a slave, gained by his plays large sums, which he lost in commercial speculations; and Terence, a slave, gained so much by his comedies as to marry his daughter to a noble Roman, and to leave a splendid house with elegant gardens. Rowe, Hughs, Philips, Locke, Stepney,

Prior, Gay, Montague, Mainwaring, Tickell, and Addison, obtained offices under the British government.

"Of the great application and perseverance of Chinese students, many anecdotes are given in the native works." "One tied his hair to a beam of the house, in order to prevent him from falling asleep, whilst another bored a hole through the wall of his cottage, that he might study by the glimmer of his neighbor's light. One poor lad suspended his book on the horns of a buffalo that he might learn even whilst he followed the plow;" another performed the duties of a domestic servant with such promptness, that he found time to retire to a corner for "diligent composition."

Exile and imprisonment have been irradiated by literary labors. Ovid, the son of a noble Roman, wrote his celebrated classic works among the Getæ, and composed poems in a barbarous language to amuse his new associates. Boethius, while under sentence of death at Pisa, wrote his Consolations of Philosophy; and Don Quixote, a classic in Spanish literature, was written by Cervantes in a dungeon. James brought to the Scottish throne the literary taste which he had acquired in his exile, exhibited before his people the graces and attractions of literary cultivation, and seduced them by the charm of his example to elegant and intellectual accomplishments. Prynne wrote as actively in imprisonment as at liberty; Maggi, during a toilsome captivity, composed erudite works; and Tasso, in a cell at Ferrara, produced several of his ablest minor pieces. A French translation of the Scriptures was made

by Saci in the Bastile; Lorenzani relieved an imprisonment of nearly twenty years by writing on Conic Sections; and the celebrated Madam Roland, just before her execution, wrote her Memoirs with such composure that her manuscript exhibited scarcely an erasure. Sir Walter Raleigh displayed as much activity in public affairs, as reflection in studious solitude. During every variety of hazardous adventure, he devoted four hours every day to study; and his History of the World, an English classic, was written, with other performances, in the Tower.

Bullenger, an eminent biblical scholar, supported himself at school by singing in the streets; and Musculus, after begging for an education, continued to labor for support, and became eminent in Hebrew literature. Postellus, a domestic in college, often forgot his meals, and, by his own efforts, distinguished himself in ancient and modern languages. The celebrated Marmontel received his education through charity; and Samuel Johnson was scantily maintained at college, ostensibly as a companion to a gentleman's son. An indigent boy, who read by the street lamps, became a Roman pontiff; and Lagrange, the French translator of Lucretius, used to eat his scanty morsel during the interval of recitations in the university. The late learned Doctor Parr, after a long succession of struggles with indigence and misfortune, took his stand among the greatest scholars of his age.

Magliabecchi, a Florentine, ate and slept in his library, and accumulated multifarious learning. Robert Hill, a tailor, lived in extreme poverty, allowed himself only three hours' sleep, and devoted himself to

classical studies. Henry Wild, another tailor, made, within seven years, high proficiency in the oriental and European languages. Purvier, a shepherd, made a version of the Scriptures; and Pendrell, in an humble station, was profound in mathematics and literature. Allan Ramsey, the author of the Gentle Shepherd, was a barber—an occupation seemingly uncongenial to pastoral poetry. Thomas Holcroft, the author of Hugh Trevor, in early life followed his mother in selling greens and oysters, often suffered severely with hunger and fatigue, studied music in a hayloft, and left works of established popularity.

Alexander Murray, whose father taught him letters on a wool-card, struggled with poverty, extended the bounds of human learning, erected a splendid monument of learned ingenuity, and delivered the most learned lectures on oriental literature, to admiring audiences, in a celebrated university. To Robert Burns no book was so voluminous as to slacken his industry, so antiquated as to damp his researches; no misfortune so severe as to repress his zeal for information, no form of indigence so withering as to prevent his extensive acquaintance with literature. William Gifford, when in the humblest station, beat out pieces of leather, and wrought out problems on them with an awl; but a long and prosperous life, during which he acquired a distinguished reputation, was an ample remuneration for his early humiliations and hardships.

Sophocles preserves simplicity and harmony, relies on form and proportion, charms with union and regularity, and proceeds with natural grace and unobtrusive delicacy. Shakspeare has richness and power, variety

and complexity, strangeness and contrast, novelty and magnificence. He unites "purity of heart and the glow of the imagination, sweetness and dignity of manners, and passionate violence, in one ideal picture," which fills the mind with the gentlest warmth, the gayest hopes, and the brightest fancies. The pious page of Jeremy Taylor glows with enchanting imagery, blushes with modest beauty, and never clogs with sameness. He rains "sacrificial roses," crowns life with gaudy garlands, and mingles death's head, with amaranthine flowers. Sir Thomas Brown has a passion for the abstruse and imaginary, for swelling drapery and impenetrable riddles. He embraces both poles, marches over chronology, scoops antitheses from fabulous antiquity, and rakes up epithets "from the sweepings of chaos."

CHAPTER IX.

DIVISIONS.

PARTICULAR commodities are elaborated in particular locations, by distinct laborers. The earth, seemingly so shapeless and disorderly, exhibits, by its accurate adaptations and reciprocal dependencies, a vast spectacle of order and beauty. The collocation of minerals, the station of plants, the habitation of animals, cause territorial divisions in human industry. The metals, alkalies, salts, combustibles, rocks, and precious stones, occur in particular formations. Variations in temperature, light, moisture, and soil, often observable within a few miles, are suitable to some vegetable variety. Some plants have such a peculiar habitation, that a small surface furnishes the whole world with a particular commodity. The several species of animals flourish in regions which suit their peculiar economy. The gradations of taste, intellect, and education, partition the various parts of an elaboration among distinct laborers.

I. Of all the metals, iron seems to be the most extensively diffused—occurring in Africa, India, Japan, Britain, France, Sweden, Russia, Spain, and in "every state" in the American confederacy. English iron of a fibrous texture occurs in secondary deposits, chiefly

in the coal formations." "A mine in Salisbury, Connecticut, yields three thousand tons annually." Tennessee annually manufactures ten thousand tons; and the mines in two counties of New York afford twenty thousand tons of ore. Kentucky, Indiana, Illinois, and Virginia, possess iron ore in exhaustless quantities. "Out of the forty-four thousand square miles which form the area of Pennsylvania, there are ten thousand miles of coal and iron." "In Ohio twelve hundred square miles are underlaid with iron;" and a certain region explored a few years ago, "furnishes iron sixty-one miles long and six wide." Each "square mile would yield three million tons of pig iron," and, "by taking four hundred thousand tons annually," it "would last two thousand seven hundred years." The most noted chalybeate waters of Britain, are those of Tunbridge and Brighton. The chromate of iron occurs in Europe, America, and Shetland; and graphite, a carburet of iron, is found in great purity at Borrowdale, in Cumberland.

Tin, found in rounded grains among rolled materials, is most abundant in Cornwall and Banca. Arsenic, the ores of which form brilliant colors, is chiefly procured from Germany and the shores of the Mediterranean, and chiefly manufactured in Bohemia and Hungary. Antimony and bismuth, two brittle metals used in printing types, are obtained from Auvergne and Germany. The principal ore of nickel is found in Westphalia; and platinum is chiefly procured from Brazil and the Ural mountains. The principal mines of mercury are at Idria, in Carniola, and at Almoden, in Spain. Lead is found in great quantities in Eng-

land, Scotland, and Missouri. The lead region of Illinois, Wisconsin, and Iowa, occupies nearly three thousand square miles. Fifty million pounds of lead are annually registered at Galena, and sometimes three million pounds await exportation. The chromate of lead, used as a pigment, is found in Siberia. Copper, which occurs in Sweden, Cuba, and New Jersey, is found in vast masses near lake Superior.

Iodine, discovered by Courtois and described by Clement, is found in sea-weed and marine animals. Bromine, which was discovered by Belard, has been detected in the waters of the Mediterranean, Baltic, and Dead seas, and in saline springs in England and Germany. Carbonate of strontia occurs native in Strontian, in Argyleshire. The borate from which the borax of commerce is obtained, occurs native in some of the lakes of Thibet and Persia. Boracic acid is found in the hot springs of Lipari, and in those of Sasso in the Florentine territory. Amianthus, the most delicate variety of asbestos, comes from Corsica and Savoy. Common asbestos occurs in Anglesey; mountain leather, in Lanarkshire; mountain wood, in Scotland, Dauphiny, and the Tyrol. Siberia contains magnets of extraordinary size, and even whole mountains of loadstone.

The principal deposits of rock salt are in Spain, Hungary, Poland, Caramania, and South America. Extensive formations exist in Germany and Austria, on both sides of the Carpathian mountains. Rock salt, according to Chardin, is so abundant in Caramania that the inhabitants use it for building houses. A plain of salt in Abyssinia is about four days' journey

across; and the salt, which is like consolidated snow, is cut and carried off by caravans. Kentucky, besides its own consumption, furnishes considerable salt for Ohio and Tennessee.

Alum occurs native in Northumberland in England; and alum and copperas beds are found in Virginia and Missouri. Soda, as a mineral, is found in Hungary, Egypt, India, Siberia, Mexico, and New Granada. Sesquicarbonate of soda occurs native on the banks of the lakes of soda in the province of Lukena, in Africa. Nitre occurs in Spain, Hungary, Persia, Arabia, India, Java, Naples, Kentucky, and Tennessee. Epsom, Bath, and Bristol, are noted for saline waters; and the waters of Saratoga and Ballston are extensively exported to other countries.

In cold countries, suitable for a dense population, mineral coal is almost invariably found. Of the extensive localities of coal, none occur within the tropics. "The United States contain, according to the best estimates, not less than eighty thousand square miles of coal, which is about sixteen times as much as the coal measures in all Europe. A single one of these gigantic masses runs about nine hundred miles from Pennsylvania to Alabama, and must itself embrace fifty thousand square miles, equal to the whole surface of England proper." On the James river near Richmond, is a region twenty miles long, rich in bituminous coal, from which gas is obtained for lighting New York and Philadelphia. The coal shipped from England in one year, was seven million tons. The black coal and the cherry coal of a slaty texture, occur in Staffordshire; and brown coal is found in Devonshire, Iceland, Saxony,

and Styria. A coal which is used for brilliant lights, illuminating gas, and ornamental snuff-boxes, is found at Wigan, in Lancashire.

Sulphur occurs particularly in the vicinity of volcanoes, as in Sicily and Italy. At Solfaterra it is precipitated in a pure state, and pits are dug for obtaining sulphuric acid. Sulphate of ammonia, in the form of stalactites, is found in Tuscany, also in the lavas of Etna and Vesuvius. Naphtha and petroleum are found in Europe, Persia, and the West Indies. Asphaltum, used for varnish, is found on the surface of the Dead Sea, and occurs abundantly in Barbadoes and Trinidad. Elastic bitumen, a rare mineral pitch, is found only in the Odin mine near Castleton, in Derbyshire; and retinasphaltum, consisting of bitumen and resin, is found associated with the brown coal of Bovey, in Derbyshire.

The greatest deposit of gypsum is that of Paris, extending twenty leagues. The baths of San Filippo are so impregnated with sulphate of lime, that the vapor falling on medallions forms beautiful casts. Chalk is found in England, France, Ireland, Spain, Germany, Italy, and Poland. In the Isle of Wight the harder kinds are employed as building stones. It is used in the construction of docks at Dover; and of the ancient buildings made of this material, the Abbey of St. Omar is said still to retain all its beautiful Gothic ornaments. Oolite, a variety of common limestone, is employed in St. Paul's church and Somerset House, The bituminous limestone of Dalmatia cuts like soap, and is used for building.

The primitive marble of Paros and Carrara, is cele-

brated for fine grain and dazzling whiteness. Alabaster is found near Coblentz, in Germany; near Cluny, in France; near Rome, in Italy. The Italian alabaster is noted for whiteness and appropriateness for large statues. The Romans also obtained alabaster from Cyprus, Spain, and Africa. Many quarries of granular gypsum are worked in Nottingham and Derbyshire in England. Egypt, Spain, France, and the British Isles, abound in colored marbles of every shade, often variegated with clouds, veins, and spots. Devonshire contains a marble which resembles Egyptian granite. At Milford, in Connecticut, are quarries of yellow and green variegated marble of uncommon beauty, resembling the verde antique. The brecciated marble on the Potomac, is finely diversified with pebbles and fragments of various sizes and colors.

In various locations in England, are quarries of freestone for architectural purposes. On the Kennebec river, in Maine, slate is obtained in tables ten feet square; and fine slates for roof occur in several counties in Pennsylvania. The Derbyshire hills, in England, afford a variety of beautiful stones for vases and ornaments. Jet, admitting a high polish, is obtained from France, Sweden, Germany and Ireland. The finest azure stone, a beautiful blue, comes from China, Persia, and Great Bucharia. Lazulite comes from Styria and Shalzburg; figure-stone, from China and Transylvania; moon-stone and argentine, from Persia, Arabia, and Ceylon. Black chalk occurs in Isla and Caernarvonshire; agatized wood, in the United States and West Indies. Emery is found in great quantities in Naxos; and adamantine spar, employed like emery

for polishing, comes from Hither India and China. Ambergris is found floating near the Moluccas, Madagascar, Sumatra, Coromandel, Brazil, China, Japan, and Africa. Amber, which is often made into ornaments, is almost entirely from the alluvions on the shores of the Baltic, in Prussia. It has been found near London, also near Trenton, Woodbury, and Camden, in New Jersey.

Aqua marina, a precious stone, is found in the United States; resinous garnet, in Norway and Ceylon. The hyacinth comes from Ceylon; the chalcedony from Cornwall; the chrysolite, from Egypt and Bohemia. The finest emeralds come from Peru and New Granada; the finest sapphires, from Burmah and Ceylon. The topaz is chiefly obtained from Siberia, Bohemia, Saxony, England, and Scotland; the most beautiful jaspers, from Germany, Scotland, Egypt, and the East Indies. Siberia and Germany supply the finest agates, which contain regular or beautifully variegated figures. The diamond is almost exclusively obtained from India, Borneo, and Brazil. The diamonds of Brazil, chiefly found in Minas Geraes, are washed from sand beds by numerous laborers.

Some plants flourish within the tropics; some, within the polar circles. The degree of heat causes great varieties in vegetation. In warm climates, leaves serve as fans and umbrellas; in cold countries they are suited for reverberating the heat, for resisting the impetuosity of the winds. Some plants bloom on the mountain; some, in the solitary waste; some, near the running stream; some, in the mighty waters. On its

own native home, a plant grows spontaneously in luxuriant beauty.

Vegetation is most vigorous in the torrid zone, and the ligneous plants increase towards the equator. The silk cotton tree, a native of Africa, is so large as to shelter twenty thousand persons. The teak of India, which is used for ship building, surpasses the oak in firmness and durability; and the mighty baobab, on the banks of the Senegal, attains a circumference of sixty or seventy feet. The calabash tree extends its branches over a barren soil, affords shelter for a tribe, and administers food to appease their hunger. The fan palm of India is so large that one leaf will cover ten men; and the banyan, which strikes its branches into the ground, forms beautiful arbors half a mile in circuit. The largest banyan has three thousand stems, and is capable of supplying seven thousand men with fruit and shade.

The torrid zone yields the most fragrant spices, and the most luscious fruits. The cahoon, banana, cocoanut, pine-apple, orange, lemon, plantain, grow with such rich luxuriance that their very fragrance is oppressive to strangers. The West Indies, for two centuries, supplied the world with tropical produce. The cocoanut tree, a native of most equinoctial countries, affords food, clothing, and shelter for the respective inhabitants. In some deserts, vegetable pitchers contain water for refreshing travelers, and the tamarind allays thirst by its refreshing juice.

The lower latitudes of the temperate zones yield the vine, mulberry, olive, wheat, barley, oats, buckwheat, and cotton, which is so extensively used for

clothing. In the higher latitudes of these zones, hemp and flax are raised in perfection, the pastures are verdant with grass, and the forests yield the oak, elm, apple, pear, cherry, currant, and gooseberry. The surface of New Brunswick is covered with magnificent trees, which the lumberers drag to the rivers for floating down when the ice melts in the spring. Mints, natives of temperate regions, are abundant in hot exposed situations, in meadows and groves.

The birch supports an intensity of cold which congeals mercury. Condolle found snow-drops in blossom beneath ice on Mount Seleve; and Parry discovered many plants in full leaf and ready to blossom while encased in ice. The pine, fir, cedar, and other resinous plants, furnish light and fuel for the rainy season, and commodities for other climates. Towards the pole every species of vegetables which yield food for man, entirely fails, and nothing appears but dwarf trees, bushes, and mosses. The moss of the Tyrol, as well as that of Switzerland, is remarkable for a bright smoothness approaching enamel. Mosses which cover the mantle of winter with verdure, shelter the roots, seeds, and germs of the more serviceable vegetables. The Lapps use moss for beds, for stopping crevices, for packing brittle wares, for dyes and medicines. Moss furnishes almost the sole food for the reindeer, so indispensable to the Lapps; and this variety grows six times as large in Lapland as in Central Europe.

Temperature is so affected by elevation, that at fifteen thousand seven hundred and thirty feet, the mountains based on the most scorching plains, are capped with perpetual snow. The climate of Equa-

dor, at an elevation of nine thousand five hundred feet, is that of perpetual spring, with fields and trees clad in perpetual verdure. The larger Asiatic islands are traversed with lofty mountains, which temper the heat of the tropical sun, and give rise to numerous streams which fertilize the soil, making this one of the most favored regions on the globe. The degree of heat is inversely as the degree of elevation; but every species of plants cannot take advantage of this compensation. Potatoes grow at an elevation of nine thousand feet higher than in England; and the larch clothes the sides of the mountains of Scotland with a delicate foliage. The shores of Titicaca, a lake in Peru, are above the limit of trees. They are enclosed with a thick forest of beautiful rushes, which supply the native with fuel, covering for huts, materials for boats, and canvas for sails.

Temperature so depends on solar exposure, that an elevated valley in Switzerland has a spot of perpetual verdure in the midst of perpetual snows and glaciers. Plains on the Himmalaya mountains, at an elevation of fifteen thousand feet, produce fine pasturage; and at an elevation above the region of perpetual snows on the Andes, in the same latitude, buckwheat and barley flourish. The French obtained soda by planting the kelpwort on the northern side of the hill, sloping towards the sea. The olive grows in no higher latitude than the southern provinces of France, and then under the most favorable circumstances of soil and aspect. It is much warmer at Nantz, in France, than at Quebec, in Canada, both being very nearly in the same latitude.

On lofty mountains the heat is reflected into a dry atmosphere, and carried off by winds without any opportunity to accumulate. Countries which abound in rivers, lakes, and marshes, are less subject to the extremes of temperature than those which are dry. The deserts of Arabia and Africa, are like immense furnaces, increasing the heat on the Mediterranean in Europe and Asia. Siberia and Russian America, being unprotected by mountains, have their cold increased by polar winds.

Some plants vary much in their power of resisting the vicissitudes of temperature. Firs are natives of perpetual snows, and of the Indian archipelago. The pine, larch, cedar, spruce, and juniper, are gigantic in size, rapid in growth, noble in aspect, and robust in constitution. Some of these trees form a proportion of every wood or plantation, and of every forest in a natural state.

Switzerland is hotter in summer and colder in winter than England. The more equable temperature of England enables the laurel to support winter with impunity, while Switzerland ill accords with its nature; but, on the contrary, grapes can but imperfectly ripen in England, while in Switzerland they afford a luxuriant vintage. Clover is cultivated on the Rhine for seed for England, the climate of which does not permit its seed to ripen. Anise grows wild in Egypt, Syria, and other countries. The short summers of England, as appears from numerous trials, will not bring the seeds to perfection; and the seeds, so much used as aromatics and medicines, must be imported from Malta or Spain for planting.

Vegetation, having more light, is of a deeper green on mountains than in valleys, in Italy than in England. Light causes inflexibility, so that mountainous plants are more diminutive than those in the plain. The Alpine plants seem rigid and stunted; the African, gloomy and sullen; the Asiatic, majestic and lofty; the American, sweet and smiling. The want of light in England, injures the beauty and vigor of vegetation; while its damp climate gives it its fine grass, its elegant meadows and lawns. Ireland, with a climate more mild than England, is, from the brilliant verdure of its vegetation, called the "Emerald Isle." Florida is noted for the brilliant coloring of its flowering shrubs, for its tall and majestic pines, cedars, chestnuts, and magnolias.

Rain is very unequally distributed over the globe, being generally much greater at the equator than toward the poles. In the torrid zone the rains occur at certain seasons; and in some places in Peru, the place of rain is supplied by copious dews. The palm, a succulent plant, grows from sands in which no moisture is observable; and many of the succulent plants embellishing Southern Africa, are destroyed by the rainy season. Rice flourishes entirely covered with water, or with its roots alone shooting into a moist soil. It grows so abundantly in the rivers and bays of Wisconsin that the Indians gather it into their canoes. The moisture of the English climate admits abundant crops of turnips, peas, and beans, plants which enter into rotation with great advantage. The water of large rivers, being more impregnated with air, is more favorable to vegetation than that of small

rivulets. The silicious soil of Ireland is suitable for corn; while a similar soil of France, as the climate requires more water than the soil can retain, is unsuitable for such cultivation.

Some plants flourish on silicious, some on aluminous, some on calcareous soils. As silicious soils are early in maturing plants, they are suitable for grains, roots, and herbage, such as barley, turnips, and perennial pastures. Aluminous soils surpass the silicious in wheat; and the plum tree "only bears its finest and most abundant crops in heavy loams, or in soils in which there is a considerable mixture of clay." Lime imparts vigor to sainfoin, the roots of which penetrate far into the interstices of chalk, and grow luxuriantly upon a light soil.

Variations of altitude, temperature, humidity, soils, proximity to the sea, particular winds, contribute to affect peculiar botanic habits. Adaptations arise from the minutest circumstances, and particular districts are supplied with particular plants. Botanists have divided the globe into twenty botanic regions. The plants which grow naturally in St. Helena and the Sandwich Islands are almost all different from those upon the continents. In India the greater part of trees is the family of the palms; and in the southern parts of Europe, a few straggling palms indicate an approach to a more vigorous region. "Palms chiefly acknowledge, as their native home, those happy regions seated within the tropics." Some few species "love the humid banks of the ocean, others ascend into Alpine regions; some collect into dense forests, others spring up singly, or in clusters over

the plains." "No species of palm has been found in South Africa," nor "on the west coast of New Holland, even within the tropics."

Barbary, from its warmth and moisture, is covered with verdure and adorned with flowers. The olive flourishes, the vine stretches itself in beautiful windings, and the Indian fig-tree forms impenetrable hedges for gardens and vineyards. Its pomegranates are three times larger than those of Italy; and oranges, melons, cucumbers, cabbages, and lettuces, abound in the richest profusion. The artichoke which grows wild in the woods, and the acorn which tastes like the chestnut, are food for the natives. The cypress, the cedar, the almond, the mulberry, flourish with beautiful foliage. The hills are covered with thyme and rosemary, which purify the air as well as furnish fuel for the inhabitants. The lotus and the palm are useful plants; and the white rose, which is seen in every direction, yields the purest essence.

The eastern regions of Asia possess the noblest plants; the western, unite richness with symmetry. Asia contains the enchanting Cashmere, the garden of Damascus, and the forest of Lebanon. Botanists have found two thousand new plants in Australia, and the richest esculent fruits grow luxuriantly in the smaller islands. The sago, areca, and cocoa trees, grow one hundred and eighty feet in height, thirty feet in circumference. The guava, rotang, and banana, afford grateful food for man, and elegant wood for furniture. The paper mulberry is manufactured into

cloth; and bread-fruit, like melons, hangs from the boughs of trees in Otaheite and other islands.

The seringeira, a common forest tree of the Amazonian valley, yields the India-rubber, so useful in domestic economy. Anotta, so extensively used as a dye, is derived from the seed of another Amazonian tree. Extensive plantations of the cocoa tree form a feature in the agriculture of the country. The mandioc, sometimes called the cassava, is indigenous to Brazil, and constitutes the bread of the people. The root, after expelling its virulent poison, is made into tapioca for commerce. Of the fruit of a palm, native to Brazil, is prepared "a cream-like substance" which "becomes more prized than all fruits besides." The mangaba, or alligator pear, has in the centre a stem about which is a substance "soft and marrow-like;" and the biraba, or custard apple, "contains a white pulp which is eaten with a spoon." From the forests of Brazil are obtained drugs of wondrous virtue; many precious gums exude from its trees; and elegant wood for various uses abound in the richest profusion.

The olive, the vine, and the maize, flourish in the most perfect manner in Tuscany; and oranges and peaches are poured from the horn of plenty with uncommon prodigality. The soil is not very favorable to vegetation; but, with an ardent sun and good cultivation, the same results are obtained as in Belgium with a superior soil. The light soils of Belgium and Alsace, are suitable to alternate and simultaneous crops, a cultivation too expensive for aluminous textures. De Soto found the granaries of the natives of Florida "well stored with Indian

corn and certain leguminous seeds." In the vale of Glastonbury wheat grows many years on the same spot without any manure; and in a particular location in Scotland, wheat has been raised thirty years successively, without injury to the soil or crop. The red lands of Morocco yield wheat most abundantly; and in the vicinity of Barcelona, lucern has yielded as high as forty tons to the acre.

Within the northern polar circle, agriculture is found only in a few places. The polar limit of agriculture is higher in Russian America than in Siberia. In Lapland the limit is seventy degrees. Barley and oats constitute the vegetable nourishment in Norway, Sweden, Siberia, and Scotland. Barley is raised even to the edge of the glaciers; the potato, as far north as Archangel. Rye is the prevailing grain on the Baltic for food; barley, for beer; and oats, for horses. Wheat almost exclusively furnishes bread in the south of France and Scotland, in England, Germany, Hungary, Caucasus, and the Crimea. Rice abounds in Portugal, Spain, Italy, Greece, Persia, Arabia, Egypt, Nubia, Barbary, and the Canary Islands.

A tree with soft, silver-colored leaves resembling satin, and a tree with gold-colored leaves edged with scarlet, are natives solely of the Cape of Good Hope. The Isle of Thanet owes its reputation to sea-weed which is used as manure; and crude soda, so useful in the arts, is obtained from sea-weed which abounds on the western shores of Scotland. The Chinese use one species of sea-weed in the manufacture of lanterns, and in giving a gloss to silks or gauzes. The cinchona grows abundantly in Peru; and a mountain in Africa

is covered with aloes. The tallow tree for making candles, grows plentifully in China; and a tree in the interior of Africa, according to Park, yields firmer and richer butter than that obtained from cows. The fountain tree on Hierro, one of the Canaries, affords drink to the natives. The balsam tree grows on rocks and the trunks of other trees, in the hot parts of America and the Bahamas. Pimento trees, which are very difficult to cultivate, grow spontaneously and abundantly in Jamaica.

Pepper is found in large quantities in Sumatra; and indigo and opium are largely raised in India for exportation. Camphor is obtained from a tree which grows very commonly in woods and hedges in Ceylon. Its respective parts yield the common cinnamon, the oil of cloves, the oil of camphor, and candles for royal use. The liquorice of commerce is obtained from a plant, a native of Italy and France; the gum-arabic, from the acacia of the Nile. Archil is obtained from a peculiar lichen growing chiefly in the Canaries; rouge, from the safflower which is cultivated in Egypt, Spain, and the Levant. Manna and senna, procured from the same tree, come from the coppice woods of Italy; and the daphne, the bark of which makes delicate lace, is a native of the West Indies. The cork tree grows in Spain, France, and Barbary. Jalap comes from Jalapa; cayenne pepper, from Guiana; mahogany and logwood, from Honduras. Catechu is prepared from a plant growing in Bahar, and comes to us principally from Bengal and Bombay. Gum copal comes from Guinea, and lac is found in great quantities on the uncultivated mountains on both sides of the Ganges.

Asafœtida, a medicine and seasoning for food, grows on the mountains which surround Desguum, a small town in Persia. The whole gathering is performed by the natives, the whole atmosphere is surcharged with the pungent perfume, and a single ship is exclusively devoted to the use of carrying the commodity to the ports on the Persian gulf. Banca, a small island destitute of most plants, could supply the world with nutmegs—the annual sale having amounted to three hundred and fifty thousand pounds of nutmegs, with a hundred thousand pounds of mace. Amboyna, one of the largest of the Moluccas, is the centre of commerce in nutmegs and cloves. It has a beautiful aspect with a salubrious climate, and possesses four hundred species of wood suitable for inlaying. The tea-plant, which is found native only in China and Japan, supplies the world with a refreshing beverage. Ten million pounds of the best coffee are annually exported from Mocha, and seventy million pounds are annually supplied by Hayti.

Hemp and flax are imported from Russia, the middle regions of which abound in apples, some of which are remarkable for size and flavor. New Jersey abounds in fine apples, and Newark cider is proverbial for its peculiar excellence. The olive trees about Nice afford oil perfectly white and limpid, free from smell and taste, and highly esteemed in northern countries. The tobacco of Cuba, from which Spanish cigars are manufactured, is esteemed the best in America. Of arrowroot, which is cultivated in the East and West Indies, the purest comes from Jamaica and Bermuda. A few states of the American Union make cotton for a great

part of the world, the interior yielding a variety for ordinary clothing, the coast a variety of a silky texture for the finest fabrics. A district of Virginia is adapted to tobacco; of Georgia, to rice; of Louisiana, to sugar; of Kentucky, to hemp; of Delaware, to wheat; of New Jersey, to corn; of New York, to barley; of North Carolina, to "tar, pitch, and turpentine."

The torrid zone abounds in large animals. The mighty elephant dwells in the depths of the ancient forests, while the rhinoceros and the hippopotamus roll their enormous bodies along the banks of the streams. The ostrich, cassowary, and condor, are the largest birds, and the smaller ones, which abound in the forests, have brilliant and beautiful plumage. The horse, ox, sheep, goat, hog, cat, dog, and other useful domestic animals, are found in great perfection in the temperate zones. In the frigid zone, the great bear roams over the fields of ice; the sea-horse rises amid the icebergs; and the mighty whale rolls through the sea, mingling his frightful roarings with the sound of the tempest.

The most magnificent animals are seen in Africa, which contains five times as many species as all America. Africa is distinguished for its gigantic ostrich, ape, antelope, hippopotamus, and giraffe. It furnishes hides, ivory, tiger skins, and ostrich feathers. The elephants of India are tamed, and made useful like horses in Europe. The camel abounds where deserts are extensive, and does not flourish in the mild climate of the temperate zone. The fox and wolf, inhabiting every zone, suffer only a variation in the beauty of their covering. The salubrious valleys of Afghanistan

abound in horses and dromedaries; and camels, sheep, and wild boars, are abundant in Barbary.

"Nature," says Laborde "has destined" the bouquetin "to mountains covered with snow; if it is not exposed to keen cold, it becomes blind. Its agility in leaping, much surpasses that of the chamois, and would appear incredible to those who have not seen it. There is not a mountain so high or steep to which it will not trust itself, provided it has room to place its feet; it can scramble along the highest wall, if its surface be rugged." The mule, in descending the Alps, stops at a descent, and prepares for the encounter. It places its fore feet in a proper posture, puts its hind feet together, surveys the road, and slides down along the winding path.

As sheep delight in pure air and dry pasture, they are well fitted for rocky situations, and hilly districts are becoming profitable sheep grounds. Dry provender is salutary food, and their fleecy covering and gregarious habits are accommodated to extreme cold. Saxony is noted for fine sheep; and Spain makes the rearing of Merino sheep a great business. In some locations in Massachusetts, the soil, as well as the farmer, is enriched by rearing sheep. A part of Australia, which has a soil unfit for cultivation, is so well adapted to pasturage that nine million pounds of wool were exported in a single season. The alpaca sheep, which is indigenous to the mountains of Peru, has a hardihood of constitution and a peculiarity of structure adapted to its native regon. It flourishes while feeding below the snowy mantle which continually envelops the summits, and occasionally clothes

the sides of the Andes. It ascends the rugged mountain with safety; sometimes climbing the slippery crag for food, sometimes seeking it on the heath, or in rocky dells sheltered from wintry storms. It enjoys its coarse pastures, its extensive ranges, its pure air, and its appropriate bathing-places. Two million pounds of alpaca wool are annually imported into Britain.

That portion of Western New York which is not adapted to wheat, is so admirably suited to grazing as to send horses and cattle to market. Steuben county is almost wholly devoted to butter making, and Herkimer makes one thousand three hundred tons of cheese in a single season. One house, in one year, shipped from Cincinnati two hundred and three thousand pounds of butter. The products of the Dutch dairies are in such high repute, that vast quantities of butter and cheese are annually exported to Britain and the West Indies. Alkmaar, in North Holland, is so great a market for cheese that eight hundred farmers with cheeses resort to it in a single day.

The horse is modified to suit his physical circumstances. The scanty herbage of the mountains tends to hardy diminutiveness; the rich pastures of the plains, to uncommon largeness. The pony of Norway or Scotland contrasts with the huge horse of Holstein or Lincolnshire. In Africa the horse displays that light, agile shape which fits him for his peculiar condition. The heavy horse of Germany and England, could no more subsist on the dry herbage of Africa and Arabia than on the scanty heath of Norway and Scotland.

Some races of hogs can scarcely be made to fatten; others raise a valuable carcass out of materials on which no other creature can subsist. The flesh of the Chinese hog, a variety diffused through China, Guinea, and the South Sea islands, is white and delicate. The New Hebrides, Marquesas, Friendly, and Society islands, possess this variety; and as it is almost their only domestic animal, they cultivate it with the greatest care.

The hair of goats turns into a silky texture by a residence at Angora. The Guinea deer, the hair of which is as bright as polished gold, can exist only in tropical climates, and abounds in Java and Ceylon. The musk animals of Thibet inhabit the Alpine mountains of Asia, frequenting woody and inaccessible places. The elk, the marten, the sable, the beaver, the ermine, have caused the polar regions to become the country of an extensive fur trade.

The extensive prairies of North America afford rich pastures for immense herds of buffaloes, elks, deer, and horses. The whole plain sometimes appears black with buffaloes; ten thousand are sometimes supposed to be in a single herd. The pampas of the United Provinces are supposed to contain twelve million horned cattle and three million horses, besides sheep in great abundance. The wealth of the inhabitants consists in vast herds of cattle, horses, and mules. Brazil, Buenos Ayres, and Russia, furnish tallow, hides, and leather. The Lapps use the reindeer for drawing sledges, and barter the oil and sinews with happier climes. The oil of the seal, with some

other parts, the Greenlander exchanges for other commodities.

Swarms of herring, cod, and other fish, come yearly from the icy seas to the Baltic, and to the shores of Britain and Newfoundland. Several hundred ship loads are sent every year from Bergen to foreign parts, besides those consumed at home in daily provisions. Mackerel come in shoals to the coasts of England; and herring move from the icy regions to Norway, the Baltic, Zuyderzee, Friesland, Holland, Flanders, France, Scotland, and Ireland. The people of Brittany purchase the offal of a large fish caught on the coast of Norway, and this brings such shoals of pilchards as to supply all the maritime places in the vicinity.

New Brunswick is distinguished for its salmon and herring fisheries. Two thousand barrels of salmon are annually exported from Aberdeen, in Scotland. The principal whale fishery is the seas contiguous to the Falkland Islands, in the Pacific ocean. The cod fisheries of Newfoundland, the richest in the world, give employment to thousands and food to millions. Ajaccio, in Corsica, is famous for its coral and anchovy fisheries. Marine turtles abound on the shores of the West Indies, and are caught as they go on the land at night. The turtles of the Upper Amazon, deposit their eggs on land, and the people collect to share the pillage. They gather them in boat loads, beat them up in huge vessels, and obtain turtle oil which is much used in Amazonian cookery. Six thousand pots of oil, each requiring twelve thousand eggs, are annually sent from the most noted localities. Seventy-two

million eggs, requiring four hundred and eighty thousand turtles to produce, are annually destroyed—only a small proportion of the whole number.

The ship-worm of India clears away timbers which block up the mariner. The murex which inhabits the South seas, is used as a musical and military horn by the New Zealanders and Africans. The murex which produces a charming purple, is common on the Tyrian shore, and abundant in the seas near Panama and Nicoya. Cloth dyed at Segovia is sold at twenty crowns an ell, and worn by the greatest noblemen in Spain. Cochineal, an insect extensively cultivated in Oaxaca, is sent to minister to the elegances of life, and to enliven with gay colors the saloons of London, Paris, and Vienna.

The woolen manufacture of England employs five hundred thousand hands ; and Silesia, in Prussia, elaborates some of the finest cloths made on the continent. The cotton manufactured in England and Wales, employs four hundred and twenty-seven thousand operatives. Deccan is noted for the finest muslins in the world ; and Lowell employs in its cotton and woolen manufactories seven thousand females. Twenty thousand pieces of beautiful and durable linen, are annually manufactured by the peasantry in the vicinity of Verona. Linen of the finest quality is manufactured in Ireland, Bohemia, Moravia, Silesia, and the Netherlands. Bohemia alone employs three hundred thousand operatives, and Silesia has whole towns and villages occupied by weavers. Russia has three hundred linen manufactories. The finest fabrics from hemp are manufactured in France, Germany, and Great Britain,

in which countries the most perfect kind of machinery has been in operation for years, elaborating from the coarsest bagging to the finest cambric.

Saxony stands at the head of the German states in agriculture, manufactures, and literature. Birmingham is styled "the toy shop" of Europe, and Brussels is noted for its lace and carpets. Sheffield is noted for cutlery; Leeds, for woolens; Coventry, for ribbons; Nottingham, for stockings; Worcester, for porcelain; Swansea, for copper works; Glasgow, for fine cottons; Paisly, for intelligent weavers; and Dundee, for sail-cloth and coarse linens. Baden is distinguished for pipes; Staffordshire, for extensive potteries; and Friburg, for being surrounded with two hundred mines. Cremona is noted for violins; Brescia, for fire-arms; Meissen, for fine porcelain; Rochester, for flour-mills; Salina, for salt works; Newark, for carriages; Lynn, for women's shoes; Bristol, for clocks; Waterbury, for buttons; Collinsville, for axes; and Pittsburg for glass and white-lead.

The fruitful valleys of Piedmont are embosomed in lofty mountains, intersected with deep and rapid rivers. Fertile plains contrast with frightful precipices; beautiful verdure, with everlasting snow. The mountains abound with gold, silver, copper, and iron; the rivers, with exquisite fish; the forests, with game; the pastures, with cattle; the fields, with corn, rice, fruits, and hemp. The chestnuts which are so plentiful in the forests, are used in France as confectionery. Some locations among the Pyrenees are destitute of verdure; others are crowned with forests of huge oaks, beeches, and evergreens. Extensive valleys are ani-

mated with deer and fowl, perfumed with aromatic herbs, adorned with aloes and pomegranates, and enriched with olives, lemons, oranges, apples, corn, and flax. Flocks of sheep and goats enliven the hills, and cultivated vegetation hangs on the slopes. Agriculturists and artificers, operating on native facilities, live in peace and plenty.

II. Discovery, invention, and execution, the three grand divisions of human industry, disperse into minute specifications. To complete a single commodity, is to concentrate the whole circle of intelligence, to mingle science with artistic inventions, to intertwine dexterity with the arts and sciences. Science, the result of discovery, is distributed among various philosophers, each of whom, after collecting information from every available source, devotes himself to a specific department. The inventors, the second division, apply science to industrial pursuits; and many sciences, which at first seem to be only speculative curiosities, possess a vast utility. The operatives, the third division, branch out into extreme minuteness in actual elaborations.

In pure mathematics, the investigation of fluxionary quantities is confined to the algebraist; the comparison of magnitudes, to geometers; and the combination of numbers, to the arithmetician. Natural philosophy, which investigates bodies in masses, is now separated from chemistry, which determines their internal constitutions. Of natural philosophers, one devotes himself to mechanics; another, to geography; another, to astronomy. The elements of machinery are brought to the highest simplicity by those who

have made mechanics a particular study. Modern chemistry, according to the three kingdoms of nature, investigates mineral affinities, vegetable energies, and animal economics. Geology, which investigates the laws of stratification, includes metallurgy; and many professors confine their investigations to specific metals.

Mathematical philosophers smooth the path for the observers of nature; and the literati furnish a medium for conducting such elaborative reasonings. The economist investigates the laws of property, reasons with demonstrative rigor, and estimates commodities with the strictest arithmetic. The financier, in his particular department, uses philosophic and mathematical principles. Commerce is conducted, merchandise computed, and pecuniary standing determined, by numbers. Arithmetic is used "in computing the wealth of nations, the value of their revenues, and the amount of their population; and in the affairs of government, for apportioning taxes, arranging schemes of finance, and regulating national expenses." Except in particular cases, civil jurisprudence does not award the particular property in dispute, but a sum of money as a numerary equivalent. Criminal offences are often measured by pecuniary penalties, and sometimes the line between death and the mildest punishment, depends upon a farthing in estimating the stolen property. The moralist exhibits the Divine legislation for regulating human conduct, and fortifies human frailty by presenting prospective rewards and punishments. Numerary equivalents run through moral science, and will bear upon eternal retributions.

The sciences, with their attendant arts, have advanced from small beginnings. Shepherds, observing the regularity of the heavenly motions, pursued their journeys across desert plains, and originated the physical sciences. A succession of gifted minds brought the first rays into practical forms, and expanded the scanty information into the full splendor of intellective reason. Those born in the infancy of civilization, depended upon simple observation, and bequeathed their labors to posterity. Ages are spent in collecting materials, and ages more in separating and combining them. Each generation enjoys a vast hoard from antiquity, and transmits it augmented by fresh acquisitions to posterity.

The Greeks seem to have derived the elements of geometry from the Phœnicians, and studied the science for mental improvement. They connccted it with statics, hydrostatics, hydraulics, and architecture. The school of Alexandria was rendered illustrious by the reputation of Euclid; and Archimedes, of Syracuse, enriched science with discoveries upon which modern admeasurements are founded, being the only one of the ancients who left satisfactory solutions in mechanics and hydrostatics. He discovered the relation between the cylinder and the sphere, and contrived engines to defend Syracuse against the Romans. Apollonius of Pamphylia wrote on Conic Sections, and Pappus of Alexandria wrote the Mathematical Collections. Diophantus of Alexandria furnished luminous methods for resolving various problems.

"Whatever may be the origin of the name, the science of algebra is ascribed to the Grecian Dio-

phantus by the modest testimony of the Arabs themselves." It was cultivated by the Arabs, Italians, English, French, and Germans. Tartaglia of Brescia, Gardanus of Milan, and Ferrari of Bologna, are highly distinguished among Italian algebraists. It has been enriched by Stifel, Recorde, Peletarius, Vieta, Harriot, Girard, Descartes, Fermat, Newton, Leibnitz, Maclaurin, Euler, Lambert, D'Alembert, Lagrange, Saunderson, Clairaut, Cousin, Templehof, Kastner, Bezout, and Vega. Arithmetic, after attaining a high degree of perfection among the Greeks, passed to the Romans. The system of notation used by the moderns, deserves to be called one of the sublimest inventions of the human mind. The French, who excel in treatises on mathematics, have elaborated splendid works on arithmetic.

The vast number of facts and experiments which Boyle recorded, led the way to brilliant results in the study of nature. The pressure of the atmosphere was noticed by Galileo, and demonstrated by Torricelli. Every species of musical instruments found in Greek works, is also found in the Etruscan. The Roman system of music is entirely Grecian ; and the laws of contrast, of light and shade, of loud and soft, of swelling and diminishing, seem to have been understood by the Romans. The most celebrated writers on music, Augustin, Macrobius, Martianus, Capella, Cassiodorus, and Boethius, were little more than copyists of their Grecian predecessors. Pythagoras knew the relation between the length of strings and their sounds ; Aristotle, the relation between pipes and their sounds. Galileo taught that the acuteness

of sounds depends on the frequency of the vibrations; Newton gave the law of transmission, and Laplace determined the correction for heat.

Astronomy was cultivated by Thales, who is said to have calculated an eclipse. Pythagoras hinted the true system; and Meton introduced the lunar cycle. Timocharis and Aristyllus made useful observations; and Aristarchus of Samos taught the double motion of the earth. Hipparchus determined the length of the solar year, the eccentricity of the orbit, and the precession of the equinoxes. Copernicus restored the true system; and Kepler, who established the existence of three important laws, gave the science a mathematical form. Bouilloud said "that the force with which the sun acts upon the planets, varies inversely as the square of the distances from the sun." Newton demonstrated the law of universal gravitation; and Bradley discovered the aberration of light. Astronomy has advanced from the rude observations of the Chaldean shepherds to the universal gravitation of Newton; from the rough calculations of the Phœnician mariners to the Celestial Mechanics of Laplace.

The earlier Greeks were so ignorant of geography, that the wildest fictions of the Odyssey are located within a few hours' sail of their own country. The description of the Argonautic expedition considers the earth as a great plain surrounded by a flowing ocean, the sea of Azof as connected with the ocean. The Athenians, correcting some of these errors, described these seas and coasts nearly as perfectly as modern geographers. The expeditions of Clearchus and Alexander into Asia, gave the Greeks an acquaintance with

distant oriental regions. The west of Europe was visited and described by the Phœnicians, who had penetrated to the British Islands. The northern parts of Europe and Asia were known in name to the Greeks and Romans, in the second century. India limited their progress eastward; the deserts of Africa, southward; and the Atlantic ocean, westward. Within these narrow boundaries, several nations were known only by name to the ancient geographers, who believed the torrid and frigid zones to be alike destructive to animal life.

Hanno, a Carthaginian, made a celebrated voyage called the Periplus; and Eratosthenes of Cyrene, a distinguished mathematician, was the founder of scientific geography. Strabo of Pontus, in the time of Tiberius, traveled through Greece, Egypt, Asia, Italy, and wrote a great work on geography. Dionysius of Charax, a contemporary of Strabo, was sent by Augustus into the east to prepare a description of those regions. Claudius Ptolemy of Pelusium acquired great distinction in geography and astronomy; and Pausanias of Cappadocia, in the second century, traveled over Greece, Macedonia, Italy, and many countries in Asia. Distant regions became familiar to the Crusaders; and missionaries penetrated into still remoter countries. Marco Polo, a nobleman of Venice, was a distinguished traveler; and John Mandeville, of England, after an absence of thirty years, returned to publish his observations.

Before the discovery of America, the science of astronomy and geography was cherished by Alphonso, Roger Bacon, Purbach, and many distinguished phi-

losophers. Muller invented an armillary astrolabe, and several other instruments useful in navigation. The use of the compass, which constitutes an era in maritime adventures, opened the gates of the Pillars of Hercules, and ushered the mariner into the broad Atlantic. No longer bound to capes and headlands, no longer creeping timidly along the shores, he is released from fear and inspired with confidence. When every beacon has vanished, this faithful guide points out the proper passage, communicates information in the thickest darkness, and remains steady in tempestuous agitations. After this discovery, the Portuguese discovered the Azores, nine hundred miles from any continent, and found beyond the equinoctial line a habitable, fertile, and populous region. They hoped to arrive at the East Indies by the circumnavigation of Africa; and Diaz, advancing a thousand miles further than any of his predecessors, beheld the lofty promontory which terminates Africa on the south. The violence of the winds, the condition of the ships, and the turbulence of the men, compelled him to return. Columbus discovered a new continent; Vasco de Gama passed the Cape of Good Hope; and several navigators sailed round the globe.

Some traditionary knowledge of chemistry was secreted in the temples and monasteries of Egypt, and much experience acquired by arts and manufactures. The Saracens first named the alembic for the purposes of distillation, analyzed the substances of acids, and converted the poisonous minerals into soft and salutary medicines. The discoveries of Priestley, Scheele, Black, Lavoisier, Davy, and Cavendish, fix

the science on an independent basis. That the composition of bodies is fixed and invariable, was discovered by Wenzel of Sweden, and his observations were afterwards confirmed without much generalization by Bergman and Richter. Higgins speaks of ultimate particles; and Dalton, from the scattered facts, gave the law of composition a full generalization, and added the law of multiples as peculiar to his own discovery. Wollaston and Thompson followed in the true path of discovery; and Berzelius, in his investigation of the laws of definite proportions, enriched the science by his skill and indefatigable industry. The composition of a substance is determinable by calculation; and the science is indebted to Lavoisier, Berthollet, Morveau, and Fourcroy, for its elegant nomenclature.

Rumford found that in proportion as fibrous substances retained heat, they furnished warmer clothing. Leslie discovered that surfaces had an effect upon radiation; and Stark performed experiments illustrative of the connection between radiation and color. That heat has the same laws of refraction as light, was noticed by Lambert, and decisively established by Saussure and Pictet. Leslie discovered that surfaces adverse to radiation were suitable for reflection, that surfaces suitable for reflection were adverse to absorption. The researches of Leslie were confirmed by the decisive experiments of Ritchie. That radiation was inversely as the conducting power, was traced out by Nobili and Melloni. Radiation afforded to Wills the elegant solution of the phenomenon of dew; and Newton's law of refrigeration, was used with success by Dulong and Pictet.

The Philosophical Transactions contain dissertations on expansion by Ellicot, Smeaton, Troughton, and Roy. Biot has given the results of experiments performed with great care by Lavoisier and Laplace. That water dilates before it freezes, was first noticed by Croune; and the elegant experiments of Hope and Hallstrom determined the degree which gave its maximum density. The law of dilatation in gases was detected by Dalton and Gay Lussac nearly at the same time. The determination of specific heat was made by the elaborate investigation of Crawford; and afterwards by Lavoisier and Laplace, Delaroach and Berard. The specific heat of the gases was experimented on by Clement and Desormes, and further tried by De la Rive and Marcet. Black discovered the loss of heat during liquefaction; and experiments on the tension of steam, were made by Robinson and Southern. Arago and Dulong.

On optics society has the discoveries and observations of Newton, Descartes, Huygens, Euler, Herschell, and Airy. Snell discovered the plane of the incident and refracted ray, and the relation of the sines of the angles of incidence and refraction in the same medium. Hooke and Franklin found that textures absorbed the rays of the sun nearly in proportion to their depth of shade. Herschell found the calorific rays beyond the spectrum on the red side, and Lubeck found the maximum point to vary with the kind of prism employed in the experiment. Ritter and Wallaston determined the place of the chemical rays to lie at the outer verge of the violet. The light emitted by lime intensely heated was proposed by Drummond for

trigonometrical surveys; and it has since been successfully applied by Cooper and Carey to gas microscopes, which give the prismatic colors in great brightness.

The ancients knew the effect resulting from the friction of amber; and Gilbert discovered the same properties in other substances, and laid the foundation of the science of electricity. Additional facts were added by Boyle, Guericke, and Wall; Hawkesbee published many curious experiments; and Gray, who made many striking experiments, drew the distinction between conductors and non-conductors. The mode of accumulating electricity was discovered; and Franklin proved the identity of electricity and lightning. Considerations overlooked by Franklin, were introduced by Æpinus and Cavendish in their elaborate expositions. Experiments on insulation were made by Dufay, Symner, Franklin, and Cavendish; and the effect of temperature was shown by Cumming, Prideaux, and Becquerel. That chemical action was a very fertile source of electricity, was ascertained from the experiments of Becquerel, De la Rive and Pouillet.

Galvani engaged in a series of experiments to prove the intimate connection between muscular and electrical action. Galvanism proved to be nothing more than electricity; and Volta showed that the organs of the frog were only a delicate test of electric influence. No sooner were the magnetic effects of galvanism discovered by Oersted, than new facts were brought to light by Ampere, Biot, Arago, Davy, and Faraday. Treatises on magnetic attractions were written by Cumming, Murphy, and Barlow. Ampere was led to his doctrine of magnetism from electrical currents, and

by connecting the facts of electro-dynamics with the phenomena of terrestrial magnetism, applied mathematical analysis to physical research. The chemical agency of the voltaic apparatus, a most powerful instrument of analysis, was discovered by Carlisle and Nicholson. Davy decomposed the earths, till then regarded as elementary, and revolutionized chemistry.

Phosphorus was discovered by Brandt, an alchemist of Hamburg; and the two compounds of phosphorus and hydrogen have been closely studied by Dumas, Buff, Rose, and Graham. Oxygen was first discovered by Priestley, afterwards by Scheele. Fluorine was first obtained in a pure state by Baudrimont. Chlorine was discovered by Scheele; and the composition of hydrochloric acid was determined by Davy, Gay Lussac, and Thenard. Belard obtained hypochlorous acid in a gaseous form; and quadrochloride of nitrogen was discovered by Dulong, and its properties determined by the investigations of Porrett, Wilson, and Kirk. Perchlorate of carbon was discovered by Faraday; and the bleaching powers of chloro-nitrous acid, by Davy, Dumas, and Rose.

Morveau determined the relative tenacity of the metals; and crystallography has been pursued mathematically by Hauy, Weisse, Whewell, and Rose. The chemical changes in germination were investigated by Saussure; and the honor of discovering the existence of the vegetable alkalies, is due to Sertuerner, a German apothecary. Tar was subjected to elaborate inquiry by Reichenback, who discovered in it no fewer than six principles. Albumen was found in grain by Einhoff, in the bitter almond by Vogel. Beccaria examin-

ed gluten; and Einhoff discovered its two principles, which Tadei illustrated by boiling alcohol. Various vegetable principles were obtained by Vauquelin, Robiquet, Klaproth, Pelletier, Horneman, Dulong, Leroux, Braconnet, Dublance, Wittstock, and Garot. Respiration engaged the attention of Priestley, Scheele, Lavoisier, Seguin, Crawford, Goodwin, Davy, Ellis, Allen, Pepys, Edwards, and Despretz. The arterialization of the blood has been investigated by Humboldt, Henderson, Pfaff, Nysten, and Spallanzani.

The science of botany involves thousands of gradations, with myriads of minor modifications. It has passed through a long series of cultivators, and received accessions from Pythagoras, Aristotle, Dioscorides, Pliny, and Galen. The Arabs cultivated it for medicinal and agricultural purposes; and the discovery of the torrid zone has enriched the herbal of Dioscorides with two thousand plants. Gesner, the Pliny of Germany, explored the Alps, discovered new plants, and arranged them into groups; and Clusius, after traveling over the west of Europe, obtained the direction of the Imperial gardens, and became professor of botany in Leyden. Cæsaralpinus, a native of Florence, proposed to form species into classes; and John Bauchin composed a general history of plants, a work evincing learned and accurate investigation. Gaspard Bauchin expresses himself decidedly upon distinctions formed by grouping similar species, and his work, the labor of forty years, was of great assistance to Linnæus in perfecting his artificial system.

Cain, according to Moses, "was a tiller of the ground," Abel offered "the firstlings of his flocks,"

and Noah "planted a vineyard." Egypt, before the destruction of Sodom, "was well watered every where as the garden of the Lord." The Egyptians ascribe the invention of agriculture to superhuman agency. The Nile, which diffused a precious deposition, gave the people a passion for agriculture, which at an early period was superintended by sacerdotal families. The Pelasgi, the aboriginal Greeks, were instructed in agriculture by Egyptian colonies. The Euphrates and the Jordan, like the Nile, carried the carbonate of lime to cultivated fields. The Carthaginians excelled their contemporary nations in agriculture; and the Romans, in the purest ages of the Republic, paid a high veneration to agricultural pursuits.

Mago, a famous Carthaginian general, composed on husbandry twenty books, which were translated into Latin by a decree of the Roman senate. Hesiod wrote an agricultural poem; and Xenophon exercised his genius on rural economy. Cato, the censor, the statesman, the orator, the general, the conqueror, the governor of provinces, derives his most durable honors from a voluminous work on agriculture. In the Georgics of Virgil, the majesty of verse adds dignity to a useful pursuit. Columella wrote twelve books, which constitute a complete treatise on rural affairs. Varro, Pliny, and Palladius, distinguished Romans, wrote on agriculture. The improvement in tillage is illustrated by a vine-dresser, who gave his daughters portions of his vineyard without diminishing his vintage.

The precepts of ancient writers were founded upon very limited experience. The mode of culture in Greece was very simple, and that of the Romans

was conformed to the peculiarity of the soil under tillage. Irrigation was a prominent feature in Lombardy; and Virgil advises his countrymen to bring down waters in channels to revive drooping fields. Pasturing too luxuriant grain, received the highest commendations from Virgil; and the general mode of culture among the Romans, meets the approbation of modern cultivators. Pliny ascribes the invention of manures to Augeas, a Grecian monarch; and the Romans collected manures from nearly as many sources as modern nations. Theophrastus mentions six species of manures, and states that a mixture of clay and sand produces the same effect as manures. Pliny, who wrote during the first century, mentions marl as having been long in use in Greece, Gaul, and Britain. He describes the appearance of nearly all the marls now known, specifies the peculiar effects of each on soils, and states the length of time which these effects are supposed to last. Varro, who wrote before Pliny, mentions having seen fields in Gaul covered with a "white fossil clay," and describes several varieties in common use.

The Celts, in the infancy of agriculture, successively brought new lands into tillage, leaving the exhausted soils to recover for another rotation. This plan is still traceable to their descendants in Brittany. They burned the natural product, an amelioration to aluminous, a deterioration to silicious soils. The system of fallows, which was derived from the Romans, was an improvement. The Normans introduced into England that improved mode of culture which was practiced in their own country, and the clergy assisted in reaping

grain and making hay. The Belgians planted two crops simultaneously, and instituted a beneficial rotation.

Experience taught practical farmers that some countries are barren or fertile in every age, and under every mode of culture. For many centuries, the barrenness of Norway and Brandenburg has contrasted with the fertility of Flanders and Valencia. Natural manures falling for ages, left some soils still noted for barrenness; and certain soils could not be improved beyond a certain degree by artificial manures. Judicious cultivators, not knowing the defect, bestowed their manures on lands naturally fertile, and left their exhausted fields to recruit by their own unassisted energies. They discovered that manures did not benefit soils which were unexceptionable in texture, moisture, and superficial inclination.

In England, Fitzherbert gave directions for enriching soils; Platt furnished many valuable hints; and Tull excited much useful inquiry. Kaimes, Anderson, and Sinclair, display considerable sagacity; and the work of Loudon is scarcely surpassed in any language. Serres, who introduced the grasses into France, published a valuable treatise; and Buffon and Duhammel gave dignity to rural studies. Societies were formed for associating distant cultivators, diffusing useful information, and profiting by each other's experiments. The societies of Paris, Bordeaux, and Amiens, have published interesting memoirs. Arthur Young made a geological survey of France; and such surveys are now made upon philosophical principles in civilized states. Several writers gave the mode of

culture in their respective districts; and Rosier and Thoin published general views. Buonaparte founded botanical gardens for disseminating useful plants, for ascertaining the most beneficial culture of the several species. Germany has public institutions for instructing youth in agricultural philosophy. Societies for diffusing information and exhibiting improvements, are common in the United States.

Literary cultivators who applied manures to favorable soils, promised equal success to every one who would use the same applications. They affirmed, that, from long experience, every soil may be urged to the highest fertility by manures; and farmers who cultivated acid soils, made profuse expenditures of manures only to be instructed in memorable failures. A celebrated writer, who had operated solely upon calcareous soils, affirms that "minerals operate only as an excitement to manures," "that mineral applications terminate in impoverishment," "that fossils expel the poor remnant of life." The applications which he so strongly reprobated, neutralize acids, fix manures, improve textures, quicken vegetation, and roll away desolation from many soils.

From the want of a chemical nomenclature, very indefinite names were given to substances by agriculturists, mineralogists, and lexicographers. Marl, a word used by various writers, affords a proper specimen. "Any loose clay is called marl," "marl is called chalk," and "marl" is "a kind of clay much used for manures." "Clay marl is a great source of fertilization," "the best manures" for certain soils "is argillaceous marl," and "pure clay is preferred for very loose

sands." "Silicious sands are called marls," "marl is calcareous clay," and "very good marls show nothing of effervescence." "Rock, clay, slate, shell marl" were mentioned in the same sentence, by a distinguished writer. Practice, founded upon such vague descriptions, often lead to deleterious results. Ruffin has taught clearly the action of the carbonate of lime, and the particular soils which are benefited by its application.

Animals under disease, have, according to Pliny, instructed mankind in various medicines and surgical operations. Sheep affected with worms, sought for saline substances, and cattle affected with dropsy, looked anxiously for chalybeate waters. The vulnerary herb was learned from goats; purgatives, from dogs; clysters, from the ibis; and bleeding, from the hippopotamus. The Chaldeans placed patients by the highway, that passengers might prescribe a remedy, and the reports of cures were preserved in their temples. The walls of the sanctuaries of Egypt were covered with medical records. The Romans derived medicine and surgery, first from the Etruscans, afterwards from the Greeks. With the exception of a few unconnected fragments, Hippocrates remains "alone among the ruins of ancient medical literature." Celsus, an elegant writer, made little contributions; Dioscorides had great authority; and Aretæus wrote with beauty of language and originality of opinion. Galen, a voluminous writer of the second century, reigned supreme till the beginning of modern times.

Aristomachus of Cilicia, according to Pliny, attended solely to bees for forty-eight years; and Philiscus of

Thrace, it is said, spent the whole of his lifetime in forests, investigating their habits. The study of insects has been rendered illustrious by Clerck, Lister, Albin, De Geer, Fabricius, and Linnæus. The giant mind of Cuvier was first occupied with the study of insects, and he associated in his labors the great Latreille, the prince of entomologists, who wrote the last volume of the imperishable text-book of naturalists for all nations and ages. Ovid represents the skillful spider contending with Pallas herself in needlework; and Virgil, when enumerating the enemies of the bee, mentions the web of the spider as a nuisance. The Latin poets describe the labors of the spider, in terms which show that the ancients had carefully studied its peculiar formation and habits. This remarkable family of invertebrate animals, has received special investigation by modern naturalists.

One devotes himself to the invention of tools, to the application of the mechanic powers to effective machinery. The several parts of machinery are inventions of artificers, who use the discoveries and calculations of philosophers. Machinists apply science to cars, ships, canals, and railroads. Architects apply the laws of gravitation in planning buildings; opticians, the laws of light in constructing microscopes; and musicians, the laws of sound in making musical instruments. The properties of metals, hemp, timber, the winds, and the atmosphere, are made to contribute to navigation. Farmers are beginning to use the observations of philosophers, the analysis of chemists, the circle of science which concurs in their particular

art. In rearing their domestic animals, they are beginning to appreciate organic chemistry.

The implements of Grecian husbandry, according to Hesiod, consisted of a plow, cart, rake, sickle, and goad. The more complicated implements of the Romans, are imperfectly described by their classic writers. Pliny mentions a plow with a coulter; Cato, plows for light and strong soils; and Varro, a plow with two mould-boards for ridging. Corn was first pounded in a mortar, then ground in hand-mills. Cattle-mills were in use, and water-mills with a hopper. In later periods public mills were turned by the water of the aqueducts; and when Rome was besieged by the Goths and the aqueducts intercepted, Belisarius constructed floating-mills upon the Tiber. The laws of gravity discovered by Galileo, have been made available in mechanics. The number of buckets, the detaining of water on them, and the proper velocity of the wheel, were problems solved by philosophers. To make mill-dams strong enough, to convey water into cities, to construct wind-mills in the most effective manner, to cause animals to draw to advantage, demonstrate the efficient application of science to art.

Nearchus says that rollers were employed by the Hindoos in disengaging the fibres of cotton from the seeds. Foot gins were used in America, till Eaves made them work by horse-power. To these succeeded Pottle's gins, which are still held in high repute in Georgia. The invention of the saw-gin, by Whitney, has conferred a benefit on society which can scarcely be estimated in money.

Hargreaves introduced the jenny which spun thirty

threads at once; and Arkwright invented a frame moved by power, to work on a vast number of threads with greater precision than the human fingers. According to his own statement, he derived his first hint from the elongation of iron bars passing between rollers. The mule, at first, carried only one hundred and forty-four threads; afterwards, more than a thousand. Sharpe and Roberts made the mule work without any human labor, except mending the threads. They made, in one year, five hundred and twenty mules, carrying more than twenty-eight thousand spindles. The application of machinery to spinning flax, though a more difficult problem, has been brought to perfection in Leeds and Dundee. A warping machine, invented by Moody, stops if a single thread breaks.

Mezzotinto engraving was invented by Prince Rupert. The method of producing raised lines on copper plates by galvanic electricity, was first published as an invention of Professor Jacobi of Russia; but Thomas Spencer of England, who had been engaged in a series of experiments for two years, had proceeded further than Jacobi in practical results. The method of hardening and softening steel-plates, an invention of Perkins, has its salutary influence upon society. Chlorine gas was employed in bleaching paper by Fourdrinier; the impression on the endless web, was removed by a pressure apparatus of Donkin; and the drying cylinder to remove galls, was added by Wilks.

The arch, which seems to have been an Etruscan invention, was employed by the Romans in bridges and triumphal structures. Galileo discovered the

limits of the magnitude of works of art, to which modern edifices conform. Carpentry is determined by the highest algebra, by problems solved by profound mathematicians and accurate experimentalists. The carpenter estimates his materials, and exhibits his plans and elevations, by rules furnished by science. Hollow shafts and masts have been introduced into machinery and ships, from a discovery of Galileo that hollow cylinders saved materials. Guericke, from a suggestion arising from Torricelli's experiment, invented the air-pump. Boyle, by the suggestion of Hooke, made experiments on the mechanical properties of air, corrected the defects of the air-pump, and rendered it more convenient and useful. It has since been improved by Nollet, Gravesande, Smeaton, Prince, Cuthbertson, and others.

A boy who was amusing himself by holding up two glasses, perceived the church spire to be much larger than ordinary. This singular fact led his father to make experiments which resulted in the telescope. This instrument has been reduced to optical principles, and improved by successive philosophers. The refrangibility which made the vision so indistinct as to render the refracting telescope almost useless, was corrected by Dolland, who fitted together the lenses of different dispersive powers, so as to make the light on its emersion perfectly colorless. The oxide of lead, used to improve the lustre of glass, makes it liable to flaws; but Guinaud of Switzerland has succeeded in making lenses, nearly twelve inches in diameter, without any such imperfection.

The steam-engine of the present time, is a combina-

tion of inventions accumulated during two centuries, and, like a mighty river, is traceable to many contributory streams. Bianca, an Italian philosopher, proposed to turn a mill by the steam issuing from a kettle; and Edward Somerset proposed using the elastic force of steam as a prime mover. The method of producing a vacuum by the condensation of steam, was discovered by Captain Savery, who, by combining this discovery with the elastic force suggested by Somerset, constructed an engine in which steam was only used for forming a vacuum. All the beautiful contrivances for regulating and economizing this vast power, have resulted from succeeding machinists.

Newcomen and Cawley, two tradesmen of Dartmouth, attempted to render the power available. The vacuum which was created below from a suggestion of Guericke, constituted the atmospheric engine. Newcomen, Cawley, and Savery, entered into partnership for making the machinery; and an accidental circumstance suggested to Newcomen a better method of condensation, by introducing a jet within the cylinder rather than by an external effusion. Humphrey Potter, a boy, contrived to open and close the valves by the machinery itself. The valves operated by the pulling of strings; and Brighton, by a plug-frame, opened and closed them exactly at the proper moment. For half a century no very important step was taken in improving the atmospheric engine.

Smeaton gave much attention to the details of the atmospheric engine, and brought it to the highest perfection. Watt commenced experiments upon steam of high pressure, which he found so dangerous as to

defer the inquiry for a season. He became convinced of the prodigious waste of steam in the atmospheric engine; and, becoming acquainted with the doctrine of latent heat, he gave his whole mind to the consideration of a method of condensing without cooling the cylinder. He contrived a separate vessel for condensation; and his plan of "separate condensation" was, in the course of a day, ready for experiment. The air-pump worked by machinery to draw off the fluid from the condenser, the rod working through a stuffing-box, was propelled upwards and downwards by steam, and the world was presented with a steam-engine.

Watt contrived to save fuel, to give uniform motion to the piston, by closing the valve before the piston had descended its full stroke. He converted the straight motion of the piston into a circular motion at the end of the beam, both for pulling and pushing. This beautiful contrivance, the result of a mathematical analysis, he perceived apparently without any chain of connected reasoning, and looked upon its actual operation with the pleasurable sensation of novelty. He converted the vibrating force of the working end of the beam to a continuous rotation by a crank. The fly-wheel, the crank, the governor, give it dominion in the most delicate manufactures.

Chevalier Edelcrantz regulated the production of steam; and Brunton of Birmingham contrived to consume the smoke. To stop the steam before the descent was completed, was performed in a peculiar manner by Hornblower and Woolf; the one by using two cylinders of different sizes, the other by a method used in a double-acting engine. Cartwright proposed

effecting the condensation without a jet, by which the liquid for generating steam circulates through the machine without diminution or foreign admixture. The ingenious inventor made the piston steam-tight in the cylinder without oil or stuffing, and the longer it works, the more accurately it fits. Trevithink and Vivian constructed a double-acting, high pressure engine, remarkable for ingenuity and elegance.

Volta constructed the pile which has been improved into the battery. The London Institution possesses an apparatus made under the direction of Pepys, each plate of which is two feet by sixty. This plan originated with Doctor Hare of Philadelphia, who gave it the name of calorimotor. Cruikshanks proposed a trough with plates of copper and zinc, and its power is increased by a suggestion of Wollaston. The battery made by Children had plates six feet by two feet eight inches. The great battery of the Royal Institution, with which Davy discovered the composition of the alkalies, was composed of two thousand pair of plates.

Bergmann seems first to have referred dyeing to chemical affinities, and verified the fact by several elegant experiments. Dufay plunged cloth made of cotton and wool into a scarlet dye; and the woolen threads became a vivid red, the cotton continued nearly white. Calico printing has been advanced by Berthollet, Bancroft, Henry, Thenard, and Roard. For bleaching, the imparting of a superlative whiteness, society is indebted to Scheele of Sweden and Berthollet of France. Their process with improvements, was first introduced into Manchester by Henry.

and Taylor. The partial discharge of the colors of a dyed ground, is an application of Scheele and Berthollet.

The mechanic arts, formerly practiced by females and servants, were employed in elaborating prime necessities in the house. As the refinement of manners in the middle ages demanded increased elegance, free persons engaged in mechanic employments. As soon as population congregated in cities, artificers acquired honorable distinctions; and the useful and the fine arts, the distinction of modern times, were frequently practiced by the same person. These arts diverge into various specifications; such as the carpenter, the turner, the wheelwright, the weaver, the tailor, the watchmaker. The same specification, moreover, has minuter operations assigned to individual workmen. The minute operations of the pottery are performed by the respective laborers. One forms the cup, another applies the mould, another turns the vessel, another smooths the surface, another applies the varnish, another glazes the vessel, another puts it into the oven. The fine arts are divided into poetry, music, architecture, painting, and sculpture; and the artists use the commodities prepared by the commonest industry.

Husbandry, in the time of the first brothers, had already dispersed itself into two departments. Agriculture in modern times, has many specifications; such as cultivating hemp, cotton, indigo, rice, corn, or sugar-cane. One operative, in the same specification, brings together the materials, another turns up the soil, another sows the seed, another gathers the fruits into the

granary. Grinding the grain, as well as baking the bread, is executed by particular operatives. Rearing animals is often confined to particular species; such as horses, sheep, cows, goats, swine, or mules. The preparation of medicines, a valuable office of chemistry, is practised by particular chemists. Peruvian bark, formerly given in large quantities, is now used in the form of sulphate of quinine; and four chemists of Paris concentrated, in one year, one thousand five hundred and ninety-three hundred weight into ninety thousand ounces, for curing twenty millions. The muriate of ammonia, which is distilled from animal substances, is confined to a few operatives, who annually manufacture twenty tons for soldering in Birmingham. A celebrated sarsaparilla vender of New York, annually puts up four hundred and eighty-eight thousand bottles, and is about to enlarge his manufactory.

Some chemists operate on metals; some, on stony substances; some, on combustibles; some, on salts; some, on vegetables; some, on animal bodies. Some smelt copper; some, antimony; some, cobalt; some, nickel; some, manganese; some, arsenic; some, chromium. Some extract cadmium; some, bismuth; some, rhodium. Some manufacture sulphur; some, coal-gas; some, amber; some, petroleum; some, bitumen; some, asphaltum; some, muriatic acid; some, chloride of lime; some, alum; some, soda; some, potassa; some, nitre; some, nitric acid; some, gunpowder; some, borax; some, sulphate of magnesia. Some refine sugar; some purify starch; some make artificial gums; some purify oils; some make soap. Some

manufacture oil; some, olive; some, almond; some, palm; some, turpentine; some, citron; some, anise; some, cinnamon; some, lavender. Some manufacture perfumery; some, wax; some, resin; some, lac; some, mastic; some, varnish; some, sealing-wax; some, nut-galls; some, ink; some, water-proof cloth. Some extract coloring matters; some purify spermaceti; some make pigments. Some prepare madder; some, safflower; some, archil; some, logwood; some, indigo; some, weld. Some bake bread; some brew beer; some make vinegar. Some make glue; some, size; some, isinglass; some, butter; some, cheese. Some manufacture tallow; some, candles; some, leather. Some make carmine; some, cochineal; some, Prussian blue.

In the fisheries, one cuts the throat; another takes out the entrails; another removes the offal; another takes out the back bone; another salts the fish; another puts them up for market. One man scrubs the whale-bone; another scrapes the root-end of the blades; another trims off the fringes of hair; another washes the bone and scrapes the hollows of the root.

Merchants, distinct elaborators, are divided into many specifications. One deals in cutlery; another, in hardware; another, in groceries; another, in dry goods; another, in fancy goods; another, in jewelry; another, in books. One deals in porcelain; another, in earthen-ware; another, in wine; another, in vinegar; another, in fruits; another, in perfumery; another, in confectionery; another, in clothing; another, in cottons; another, in woolens; another, in silks; another, in linens; another, in umbrellas; another, in canes; another, in thread; another, in laces; another,

in shoes; another, in combs; another, in snuff; another, in clocks; another, in toys; another, in drugs; another, in flour; another, in school books; another, in prints; another, in charts and nautical instruments.

The dyeing establishments of the Roman empire were supported at Tarentum; and dyers from various places resorted to Phœnicia for instruction in the art. The old linen of one country is transported to another to make paper—a beautiful fabric, ready to receive and transmit wisdom, business, and friendship, to distant ages or places. Bones are picked up, carried to the factory, made up into soap-fat, lampblack, carbonate of ammonia, sulphate of soda, and muriate of ammonia. The tanner separates the horns to sell to the mechanic, who works them up into combs, knife-handles, glue, soap-fat, transparent substances for lanterns, and manure for farmers. Bone-dust manure in Lincoln shire has made the crops many times heavier, and a vast quantity of it is annually imported into Great Britain. Bone mills have lately been established near Boston, Providence, Albany, and New York.

The arts and sciences exhibit many curious intersections. The astronomer depends for his telescope upon the co-operation of many arts, and, in return, his observations are the basis of calculating the planetary motions which guide the mariner across the ocean. The ship-master does not sail to India without the "Practical Navigator," which contains rules drawn from the highest astronomical science. Every mate, who works a lunar observation to ascertain the ship's longitude, employs tables which interweave the discoveries of Newton with the calculations of Laplace.

To perform these calculations, required the aid of tables gradually formed from the profoundest investigations of a long line of philosophers, who devoted themselves to mathematical studies. The observer furnishes elements for the calculating astronomer, and the calculator derives expeditious methods from the pure mathematician. Bowditch used the logarithms of Napier and the infinitesimal analysis of Newton, and Newton used the algebra of the Arabs and the geometry of the Greeks.

Nature so interlaces human pursuits, that the philosopher who seems to dwell among the stars, requires the aid of numerous artificers for prosecuting his studies. The astronomer, in return, furnishes important facilities to the sister sciences, the arts, and the humblest manual industry. The factory for casting his lenses, requires a building with a furnace, and the manufacturer of glass employs the carpenter and the mason to execute these respective structures. The materials for making and coloring glass, come from different regions in ships which employ ship-carpenters, weavers, and metallurgists. Each art is connected with the others in the nicest convolutions. The mason who builds the furnace, neither makes his own bricks nor burns his own lime, two elaborations which come from different locations. The brickmaker does not cut his own wood, a commodity which is carted in wagons and conveyed in boats. The carter does not make his own wagon, nor does the boatman construct his own vessel. The man who makes the wagon, does not make the tire; and the smith who makes the tire, does not smelt the ore.

The man who smelts the ore, neither builds his own furnace, nor digs his own mine; and the man who digs the ore, neither makes his own pick, nor the pump which keeps out the water. The pump-maker did not discover the atmospheric pressure; but the principle of pump-making was discovered by a mathematician of Florence, as he was experimenting with a glass tube.

In the fabrication of a yard of printed cotton, the arts and sciences cross like the warp and woof of the manufactured commodity. The cotton-mill, the steam-engine, the complicated machinery, the hydraulic press which forms the fabric into a bale, the railroad which conveys it to market, illustrate these curious intersections. The spinning machinery is constructed upon the demonstrations of transcendental mathematics, and the bleaching and dyeing result from the profoundest researches of modern chemistry. The chemist determines the mordant which fixes the color; the geographer describes the country which affords the dye; and the astronomer demonstrates the rule which guides the ship across the sea. To convey the cotton from Alabama, the indigo from Bengal, the oil from the fishing grounds of the Pacific, requires ships, with the sciences, arts, and occupations necessary in building such complicated structures. The cotton-gin, the carding-machine, the power-loom, the sciences and arts employed in constructing the various machinery, play their part in completing this single commodity. To manufacture a yard of calico which costs ten cents, employs every science, every art, every occupation under heaven.

CHAPTER X.

THE MENSURATION.

EVERY commodity, with its minutest parts, is estimated by the nicest geometry. Human labor, elicited by human wants, is a mathematical induction which has been already illustrated by so many particular examples. Labor, like gravity, is embodied in substances. Gravity is ascertained by the balance ; labor, by the exchangeability in the mart. The proportionality of gravitation is a fixed quantity ; the proportionality of elaboration is always flowing, and, in every stage, is always indicated in the market. As the labor which generates commodities is measurable by mathematical principles, a moderate understanding enters into the mensuration with the greatest facility. The enumeration of the variegated results by applying a single principle, introduces the greatest simplicity into this elegant science.

The movements of commodities, like those in other systems, result from forces which always preserve a salutary steadiness. These forces, unlike those of other systems, are known by the most impressive experience. Other systems have forces which are difficult to discover ; the system of labor has intellectual

forces which are inseparable from human beings. The want of commodities and the labor necessary to obtain them, are forces exemplified in the commonest experience. Want, an apparatus coiled up in the human bosom, keeps up constantly an impetuous working, a perpetual panting for food and raiment, for houses and equipage, for trinkets and furniture. The elaboration of commodities is fully illustrated in men's daily employments. As no genii come at his bidding, man is necessitated to toil for the satisfaction of his wants; and a thousand daily sensations, at the anvil or the loom, define elaborative cost with the most impressive nicety. As the student finds these forces in his own person, he need not resort to costly apparatus or extensive libraries.

Want is perpetually attracting commodities; the toil of elaboration is perpetually repressing its ceaseless impetuosity. These forces give direction to human pursuits, proportionality to commodities, and stability to the Industrial system. The possessory affection which constitutes demand, is always pressing with determinate urgency; and nature, which affords the supply, is always yielding with determinate liberality. To the most imperious demands—the necessaries of life—nature yields with little reluctancy; to the secondary demands—the embellishments of civilization—she gives up her bounties with a more parsimonious hand. Nature neither demands an excess of labor to reduce man to a machine, nor a deficiency of exertion to sink him into the brutal ranks. The pressure of want and the liberality of nature, existing in various degrees of force, cause the quantity of the respective commodities

and the amount of labor expended in their procurement, to appear in endless variety.

Silver is so much more demandable than gold, as to bring about fifty-fold more of it into the market. Nature, moreover, yields silver with so much more liberality, that the labor of obtaining an ounce of gold is equivalent to that of obtaining sixteen ounces of silver. Specific labor, the actual toil embodied in given substances, explains the philosophy of the mart in its minutest details. Assuming a cubic inch of water as a standard, the specific gravity of mercury is fourteen; so, assuming an ounce of silver as a standard, the specific labor of gold is sixteen. The specific labor of every commodity is always expressible in ounces of silver, accurate measures of the Industrial attribute in substances. A bushel of rice is equivalent to three ounces; a yard of cloth, to four; a barrel of flour to six; an acre of land, to twenty; a piano-forte, to two hundred. Specific labor, or price, is always indicated by the exchangeability in the mart at any given period.

Price, being a fluxionary quantity, is different at different periods, and is always adjusting itself to progressive improvements. At Athens, in the time of Solon, a sheep was equivalent to a bushel and a half of corn; in England, a few centuries ago, a pound of corn was equivalent to a pound of meat; and in the Highlands of Scotland, at a later period, a pound of oatmeal, according to Hume, was equivalent to a pound of beef. Potatoes, in the sixteenth century, were "noticed among the articles provided for the queen's household," and "the price was two shillings a pound." Two cauliflowers cost two shillings; sixteen artichokes,

three shillings and fourpence. The labor employed in agriculture, through the successful application of science, has in some places quadrupled in efficiency, and affords abundant food at diminished prices. The labor employed in the cotton manufacture has, within a century, acquired more than a hundred-fold efficiency, and greatly reduced the price of cotton goods in modern times.

Price, being the average result of fluxionary quan tities, is a measure which possesses unusual accuracy. The specific labor of commodities, a variable quantity has numerous averages arising from its fluxionary na ture. Human want, a variable quantity, is ascertained, at a given period, by the number of ounces of silver offered for a particular commodity; and as the want of the whole community acts upon the same commodity, the average intensity is most accurately exhibited in ounces of silver. Some elaborations are estimated above, some below the medium cost; and the mean proportional of the several estimates, stamps the price upon the respective commodities. What is lost in one, is gained in another Industrial pursuit; and as the averages among the respective elaborators are so very numerous, the estimation of Industrial intensity is made with extreme exactitude. The average price, like the magnetic needle, vibrates freely till it settles down with certainty and firmness.

The first averages occur in the family circle. The possessory attraction, like gravity in bodies, dwells in the several human beings. As the gravity of bodies is centred in a single point, so the possessory attraction of families is centred in the patriarch, the family

representative. The same Divine wisdom that placed the material universe in systems, "setteth the solitary in families." The gravitation of a primary planet includes its satellites; so each member of a family makes a demand through its representative, who modifies as well as represents the family wants. Each family is a unit in the mart. The family is a reservoir into which commodities flow, and from which each member receives continuous supplies. The patriarch gathers around him a circle of dependents; and the store of accumulated commodities, like a Cartesian system, is an orb with a vortex of its own. The defenceless individual is supplied with commodities from distant locations, through a patriarch; and the stability of the system is promoted by placing the human species in family groups.

The same patriarch who is urged by the concentrated wants of a family, directs the concentrated labor of the same group for its united sustenance and embellishment. As the labor of the family community is directed by patriarchal authority, the industry of the whole group, as well as its wants, is regulated with superior intelligence. The aggregate labor of each family is compared with the aggregate labor of every other family; and the competition of these family aggregations, produces those movements which keep up the salutary equilibrium. The few competitors of a rude society, occasion long vibrations; the many competitors of a cultivated society, occasion short vibrations in price. The fluxionary vibrations, in every case, adapt themselves to social improvements.

The labor of a family is sometimes so employed that

none of it is directly consumed upon its own wants. The elaboration of the most commodities with the least toil, is the sole rule which guides the respective patriarchs. As a bird moves in cycloidal curve to reach its destined spot in the shortest time, so the patriarch pursues a circuitous industry to gain the most equivalency with the least exertion or toil. Every one avails himself of the particular advantages of his situation, to work on the particular materials furnished by nature, to consult his own genius or disposition, to apply himself to the task in which he is best qualified to succeed. The woodman betakes himself to the culture of his timber; the owner of a clay pit, to the supply of the potteries; the shepherd, to the care of his flocks; and the husbandman, to the cultivation of his fields. The mariner resorts to his ship; the merchant, to his counting-house; the mechanic, to his shop; the philosopher, to his study; and the chemist, to his laboratory. The saving of labor, not the variety of material or industry, is kept constantly in view. The patriarch endeavors to transfer the family labor into the most lucrative channel, and suffers no distinction of material or mode of labor to divert him from pursuing superior profitableness. The particular variety of industry employed in elaboration, is merely a speculative curiosity; for every variety sometimes enters into a commodity, by curious intersections and surprising multiplicity.

Two distinct classes, venders and purchasers, are continually in the mart, with directly opposite interests. Venders strive to raise their elaborations to the highest price; purchasers, to depress the same

elaborations to the lowest possible point. Each class meets with that active competition which fixes price upon the several commodities. As no commodity in the market is isolated, every portion is acted upon by antagonist forces ; and as equivalent commodities are estimated by mental comparisons, they possess, like the radii of a circle, a mathematical equality. The same family being both a vender and a purchaser, comes into competition in vending and purchasing. As each family elaborates commodities for another's use, a comparison of labor necessarily arises.

The sum offered is a mathematical expression of an internal want ; and purchasers being limited by their actual resources, fix the average demand with mathematical exactitude. Want seeks the least toilsome road to acquisition ; and the respective families being in continuous competition, one does not suffer another to enjoy a permanent advantage. The activity of competition precludes a lasting advantage in any particular pursuit. Superior profit is a stimulus, inferior profit is a repulsion to elaboration. Labor, like atmospheric elasticity; rushes into vacant channels, which, when replenished, impel it into other employments. The keenness of competition suffers the profits of no commodity to far outstrip another ; for, as soon as profits fall far behind the ordinary average, some immediately cease to elaborate the unprofitable commodities. As soon as the wave of price rises, some turn to the profitable employment ; as soon as the wave sinks, some turn to more lucrative pursuits. Competition, in the long run, causes exchangeability to coincide with actual labor in commodities.

As the weight of a body, multiplied by its velocity, gives its momentum; so the quantity of a commodity, multiplied by its price, gives its sum, or its momentum in the mart. The quantity and the price, the two factors, often change without affecting the actual equivalency. The two factors always flow in opposite directions; the greater the quantity the less the price, the less the quantity the greater the price. The farmer employs a given amount of labor in cultivating his plants, and receives nearly as many ounces of silver for scanty as for abundant harvests. As the quantity of his corn is enlarged, the same labor being more extended, has less intensity; as the quantity is diminished, the same labor being less extended, has a greater intensity. As one factor increases as the other decreases, the sum remains nearly stationary; and the equivalency of the mass, compared with silver, is nearly a constant quantity. The fluxion of both factors in opposite directions, tends to equalize the labor in equivalent commodities. The exchangeability, the result of competition, is the only mode of ascertaining industrial proportions. As each family elaborates commodities which are used by other families, a partial failure inflicts no very serious calamity. The fluxionary provision of nature, like an insurance company of society, spreads a partial calamity over the whole community.

The industrial momentum, a slightly variable quantity, soon returns to its medium condition. It is equalized by numerous averages, and has less vibrations as civilization multiplies human pursuits. Some momentums, as both factors are nearly stationary, are in

equipoise; others, as the factors are exceedingly variable, flow rapidly into equilibrium. In agriculture, some elements contribute to ripen; some, to blast his harvest. As the price of every variety of plants does not fall at the same time, every new plant affords additional security. The season which is injurious to one plant, is harmless to another; hence, the more varieties in cultivation, the less the chances for suffering from unpropitious vicissitudes. To restore the system to an equipoise, only a few elaborators change their employments, and those few are the versatile in disposition. As those who are entering into active life choose the vacant channels, few are compelled to leave their favorite pursuits.

Vibrations are beneficial and necessary results. The excursions from a medium condition, after reaching a definite limit, instantly recoil. Those vibrations which play far from the average condition, like those in a storm, are rapidly restored; and those which move through long periods, like those in the solar system, are almost imperceptible quantities. Hazardous pursuits suit the adventurous; constant ones, the cautious elaborator. The fluxionary provision is so adjusted as not to disturb the general constancy. Nature has provided the simplest apparatus for effecting, so rapidly and efficaciously, the astonishing result of equalizing the labor embodied in equivalent commodities. The particular forces which are neutralized, like common quantities in algebraic equations, are counted for nothing. The ultimate result is produced as surely and elegantly, as the apparatus employed is efficacious and simple.

The smallest portion of labor which enters into a commodity, is estimated by mathematical principles. The several portions taken from larger commodities, are distributed through the given commodity in extreme minuteness. A loaf of bread has numerous portions of labor, each of which had its average price while existing in larger quantities. Not only the toils of the plowman, miller, and baker; but also the labors of breaking the oxen, constructing the plow, sowing the seed, felling the timber, forging the iron, building the mill, dressing the stones, erecting the oven, enter into this necessary commodity. The artificers are employed upon iron, wood, leather, bark, stones, bricks, coal, lime, cloth, masts, ropes, and other commodities too numerous for insertion in the catalogue. These minute labors, employed upon Divine gratuities, exemplify the estimated industries which enter into a single commodity.

The minuteness of Industrial portions are more impressively illustrated by a separation into distinct orders. The wages of those artificers who labor immediately upon a yard of woolen cloth, constitute the first order, each contributing a very minute portion. Artificers of the second, make tools for those of the first order; and since this second remove brings in a multiplicity of workmen, the portions are subdivided in still greater minuteness. Labor of the third order, being employed in constructing machines for making tools for the second order, is dispersed into still minuter portions. Labor proceeds to remoter orders, extenuating itself as it radiates farther from the first centre.

The yard of cloth, the manufactured article, is composed of various elaborations which formerly existed in larger quantities. The wool, the oil, the dye, the mordant, existed in larger masses before their transfusion into the cloth; and the joint labors of a multitude of remunerated artificers, are averaged over the diminutive fabric. The shepherd, the sorter, the comber, the carder, the dyer, the spinner, the weaver, the fuller, the merchant, all join their respective arts in its completion. The equivalency of each contributor of the first order, is very small in every yard.

The tools of the first order were made out of existing elaborations, the consumption of which is an item of expense entering into the cloth. The miner, the mason, the forgeman, the woodman, the collier, the brickmaker, the blacksmith, each receive a compensation for their labor in fabricating the shears for clipping the wool. The carding-machine was elaborated by several artificers, who derived assistance from remunerated philosophers. The dyer uses drugs from distant regions, and instruments made by several workmen for stipulated payments. The apparatus of the spinner was constructed upon scientific principles, and caused a complication of wages to be distributed among the respective contributors. The loom of the weaver, the mill of the fuller, dispersed stipulated sums among various artificers. The merchant has a warehouse erected by many workmen upon various materials; and the mariner has a complicated vessel constructed by ship-carpenters, rope-makers, sail-makers, and inductive philosophers. The vessel, with its rigging and charts, transfuses a small portion of its

cost into the imported drugs. The remuneration of artificers of the second order, as it decreases in a geometrical series, constitutes a minute portion of the labor embodied in the given cloth.

The transfused labor grows more minute as it turns in every direction into the successive commodities. The apparatus employed by the second order of artificers, was constructed by the third order. Husbandmen, planters, shepherds, architects, painters, seamsters, astronomers, geographers, chemists, machinists, meteorologists, weighers, gaugers, botanists, paper-makers, type-founders, inkmakers, compositors, proof-readers, pressmen, book-binders, engineers, instrument makers, carmen, sailors, and supercargoes, receive a remuneration, part of which enters into the price of the cloth after various windings. The labor of each artificer of the third order, is dispersed into smaller portions among the commodities used by the second order. These minute portions of labor enter into the commodities used by those who finish the cloth.

The mensuration is impressively illustrated by beginning at the remoter orders. An artificer of the tenth order finishes a tool of which iron constitutes a tenth portion, and this tool is used by another artificer in making a machine of which the original iron constitutes no more than a hundredth portion. An artificer uses this machine in constructing an engine of which the original elaboration constitutes only the thousandth part of its actual cost. This engine is employed in making a particular part of another machine, of which the original elaboration contributes only the ten thousandth portion in the expend-

iture. This part again spreads itself over another tool, which extends the tenuity of the original elaboration to the hundred thousandth degree of its original intensity. The original elaboration, on reaching the first order, has diminished in intensity to the ten thousand millionth degree.

Every portion of labor which enters into any commodity, is measured by fluxionary principles. The price, at any specified period, is seen in the mart, and estimated in the minutest details in the successive periods. As the original elaboration decreases as the superadded intensity augments, every commodity contains a given amount of labor in its whole mass. The wear of the wheels, the waste of putty, the loss of emery, augment the price of cut glass. The different parts of dress are made up of a succession of infinitesimal quantities, which, like infinitesimal atoms in the universe, are only appreciable in larger bodies. The tailor, in making a coat, slowly consumes a needle which was formed by successive artificers. Minute labor enters into shoes, beds, household furniture, grates, and the coal which is dug from the earth, and conveyed by a long sea and land carriage. The bread, the tea, the beef, and the sugar, were elaborated by successive laborers; so also the kitchen furniture, consisting of spoons, knives, forks, and plates. Multitudes contribute to each commodity, and receive a proper equivalency for their respective contributions.

CHAPTER XI.

THE DISTRIBUTION.

The several portions of the same commodity, though elaborated in distant regions, flow into the nicest articulations. The fruits of Portugal and Barbadoes mingle in the same repast; the pith of an Indian cane sweetens the infusion of a Chinese plant. A private citizen, without tempting the deep, uses coffee from Mocha, oranges from Florida, figs from Italy, raisins from Malaga, sugar from the West, and spices from the East. The scarf comes from the torrid zone, the tippet from the polar circle, the brocade vest from Peru, and the diamond necklace from Hindostan. One clothes himself with vegetable fleeces from Alabama, with warm furs from Hudsonia, decorates his person with pearls polished in the Persian Gulf, and walks on carpets manufactured in the dominions of the Great Mogul. The bounties of distant regions are transfused into every city, town, village, hamlet, and cottage.

Commodities are collected together by merchants, the commercial ambassadors. Elaborators cast their surplus commodities into the proprietary reservoir, and merchants distribute them throughout society. Merchants, one of the varieties of elaborators, are useful

wheels in the social structure for distributing salubrious plenty. As each contributor takes away those commodities which supply his family wants, a vascular system is made to run from the reservoir, which propels commodities with mighty pulsations to the remotest extremities. Merchants, actuated by lucrative motives, supply the community, without exposure to boisterous seas, malignant climates, or barbarous nations.

Distribution is a variety of human industry; and man, in his efforts to acquire, gives efficacy to the distributive law. That commodity which forms no part of his private accommodation, procures for the elaborator any other commodity which he deems most desirable for his own conveniency. As no merchant can long pursue an unprofitable trade, the real spring of commerce is continuous advantages. The equilibrium is so rapidly restored, that the profits of every department of labor are very nearly stationary. Industry flows to agriculture, to the arts, to commerce, as soon as one employment becomes more efficacious in supplying human wants. As every commodity is attached to the best market, price acts as a delicate balance for weighing out the bounties of Nature, for prolonging human subsistence till the fruits of another season are brought to maturity. This beautiful contrivance turns the world into a common mart.

The fluxion of price, like water upon a mill, so regulates itself as to secure an accurate distribution. Distribution, from an exact mensuration, accommodates itself to the prospective quantity; and the annual products of the earth are so distributed for consumption,

as to last till the new supply can reach the mart. An increase of quantity so diminishes the price, that the husbandman does not receive an augmented revenue. As the possessors of corn are desirous to sell out during the year, they so fix the price as to vend their produce before the next year's supply comes to maturity. In propitious seasons, the community consume more corn than usual; and a scarcity immediately raises the price, which, like a scarcity in a ship, puts every one on short allowance. As that which remains after the new supply arises, must be sold at a diminished price, the holders of corn fix the price no higher than to prolong consumption to the end of the year. If consumption begins too briskly, prospective scarcity so raises the price as to slacken the rate; if consumption begins too sparingly, prospective plenty so diminishes the price as to freshen up the rate. By means of this fluxionary provision, consumption is prolonged evenly over the whole year. The annual tide of price rolls uniformly high during unpropitious seasons, and the ripples which occur in the intervals, contribute to preserve the general equilibrium. The consumption of each respective commodity is, by the fluxionary process, spread over a definite period.

The fluxionary price distributes commodities over space as well as over time. The city of New York, which sometimes contains no more flour than will suffice for a few weeks, is never without that necessary commodity. As soon as a scarcity occurs, the elevation of price causes an influx which soon sinks the price. Price sends food to the millions congregated in cities, in the proper quantity, at the proper time. The

same fluxion pertains to every commodity ; and a gentle vibration, by propelling commodities to market, preserves the equilibrium.

The fluxion of price sends commodities to distant locations, for receiving additional industry. A commodity sometimes takes a curious circuit to arrive at completion ; and the cost of transportation, in each successive stage, is less than the disadvantages of completing the manufacture in its present location. Intermediate distribution is illustrated by a pound weight of muslin, which was recently sent from Glasgow to London. The cotton, an elaboration of America, was sent through London to Manchester, and there manufactured into yarn. The yarn was sent to Paisley to be woven ; the cloth, to Ayreshire to be tamboured ; the fabric, to Dumbarton for another operation. After being returned to Paisley, the commodity was sent to Renfrew to be bleached, and then made a third visit to Paisley. It was sent to Glasgow to be finished, and then to London to be sold. The expense of conveying the elaboration three thousand miles by sea, and nine hundred and twenty by land, was inconsiderable, while the price, in the mean time, increased two thousand per cent. in the various operations.

Commodities find their appropriate markets. Phœnicia, which possessed an unfruitful territory, attracted "gold and silver into its treasuries," ornamental manufactures into its saloons, and agricultural commodities into its granaries. Tyre, "situated at the entry of the sea," became "a merchant for many isles," and her ships were constructed of the finest materials by foreign artists. The planks were made of the "fir trees

of Senir;" the masts, of "the cedars of Lebanon;" the oars, of "the oaks of Bashan;" the benches, of ivory from "the isles Chittim;" and the sails, of "fine linen with embroidered work from Egypt." The Gebalites were her ship-carpenters; the Sidonians, her mariners; the Persians, her mercenary soldiery. The merchants of Tarshish traded at Tyre, with "a multitude of all kind of riches, with silver, iron, tin and lead;" the Javanites, "with vessels of brass in her market;" and the Togarmeans, with "horses, horsemen, and mules." The Dedanites traded in "horns of ivory and ebony;" the Israelites, in "wheat and honey, oil and balm;" and the Syrians, in "emeralds, purple and embroidered work, coral and agate." Damascus traded in the "wine of Helbon, and white wool;" Dedan, in "precious cloths and chariots;" Arabia, in "lambs and goats;" and Sheba, in "spices, precious stones, and gold."

The Sidonians and Tyrians were the most enterprising merchants in ancient times. Astronomy, after its decline in Chaldea and Egypt, was applied to navigation by the Phœnicians, who became factors for nearly the whole commercial world. Their ships frequented the Mediterranean, passed the straits of Gibraltar, and visited the western coasts of Africa and Spain. They held, at the same time, several commodious harbors on the Arabian Gulf, and, after the manner of the Egyptians, established a regular intercourse with Africa, Arabia, and India. They imported from these countries many valuable commodities, and, for a long time, engrossed that lucrative trade without a rival. They landed their cargoes at Elath, the safest

harbor on the Red Sea, carried them to Rhinocolura on the Mediterranean, and, after reshipping them, transported them to Tyre.

The vast profits of the Phœnicians excited the Jews, in the time of Solomon, to pursue a similar trade. The pastoral pursuits of the Jews made them somewhat averse to manufactures. They established an emporium at Ezion-geber for trading with the Eastern seas, while their connection with the Tyrians enabled them to participate in the Mediterranean commerce. As they received linen yarn from Egypt, this commercial intercourse improved their manufactural industry. The large spinning factories of Egypt exported yarn, while, at the same time, the weaving establishments of Palestine furnished cloth for foreign trade.

The Rhodians obtained the sovereignty of the seas nine hundred years before the Christian era, and were celebrated for their naval power and discipline. The Athenians kept up a very busy intercourse with the Greek colonies in Asia Minor, on the borders of the Euxine and Hellespont, in the islands of the Ægean, and in Sicily and Italy. Attica was favorably situated for commerce; and its merchants, besides receiving the corn, wines, and metals, which came from various places on the Mediterranean, imported timber, salted fish, woolen and other stuffs, from Asia Minor and Syria; and honey, wax, tar, and hides, from the cities on the Black Sea. They exported the different products of Attica, and the foreign commodities brought for exportation.

Carthage, a colony of Tyre, surpassed its parent state in naval affairs. The Carthaginians passed the

Straits of Gibraltar, visited the coasts of Spain and Gaul, reached the more distant shores of Britain, and sailed south along the western coast of Africa, till they arrived almost at the tropic of Cancer. They discovered the Canaries, the utmost boundary of ancient navigation in the western ocean, and planted colonies to accustom the natives to civilization and commerce.

Ceylon, from the earliest times, has been celebrated for its trade with India, Persia, and Ethiopia. Nearchus, Arrian, Pliny, and Ptolemy, mention its commercial importance, and subsequently its trade was carried on by merchants from Arabia and Malabar. Arabian merchants emigrated to the island, founded eight flourishing cities, and advanced it to its greatest commercial prosperity. Their trade extended into Egypt, Arabia, Persia, India, China, and the intervening islands. In the twelfth century, Ceylon had become the rendezvous of the merchant princes of the world, and merchants from the remote countries of Asia expected arrivals from its markets.

Under the Roman domination, the fleet of Egypt was fixed at a certain period; and the lucrative trade of Arabia and India flowed through the port of Alexandria into the Roman provinces. As soon as the rich cargo had been transported on the backs of camels from the Red Sea to the Nile, it descended to Alexandria, and poured into the Roman capital and empire. In the time of Alexander Severus, a catalogue of Eastern commodities mentions "cinnamon, myrrh, pepper, ginger," "the whole tribe of aromatics," "a great variety of precious stones," "Parthian and Babylo-

nian leather, cottons, silks, both raw and manufactured, ebony, and ivory."

The renowned Hanseatic Association, which began in the thirteenth century, originated with the cities of Lubeck, Bremen, and Hamburgh. The Hanse towns became the asylum of commerce and the retreats of civilization, when the rest of Europe was subjected to the iron sway of the feudal system, and the northern seas were infested by "savage clans and roving barbarians." The association became so safe and beneficial a confederacy, that all the cities and large towns on the Baltic and the navigable rivers of Germany, to the number of eighty-one, acceded to the union. Magnus and Olaus, the historians of Sweden and the Goths, give a glowing account of the former wealth and commercial prosperity of Wisbury, the ancient capital of Gothland, and then a free and independent city. It was once the most celebrated and flourishing emporium in Europe—a resort for merchants from all parts.

The discovery of a passage to India by De Gama, as well as the discovery of America by Columbus, produced a prodigious effect upon commercial pursuits. The English, the second people that ventured to the new world, did not relax their commercial progress. Mary endeavored not to interfere with the Spanish monarch, as to an intercourse opened with Russia in the preceding reign. On the accession of Elizabeth, commenced a period highly auspicious to the extension of commerce. Domestic and foreign tranquillity fostered the rising spirit. Drake circumnavigated the globe; and the English became impressed with confidence in their own courage and abilities.

Great Britain having discovered a passage to Archangel, opened a beneficial trade with Muscovy. English merchants ventured into the Russias, transported their goods along the Dwina in boats, carried them up this stream in larger boats, conveyed them by land to Yereslau, and wafted them down the Volga to Astrakhan. Their goods were then shipped across the Caspian, and distributed into Persia.

At present, Hamburgh is the dépôt of the numerous elaborations of Saxony and Bohemia, the principal channel of trade between Great Britain and the German States. Frankfort exhibits great commercial activity; Bremen has a vast intercourse with America; and Leipsic is the centre of trade with the interior of Europe. Trieste, a dépôt of the Levant elaborations, imports British goods, and the produce of the Newfoundland fisheries. Prussia trades along the shores of the Baltic; and Denmark transports the elaborations of the Indies on the Baltic and Mediterranean. France trades with every country, has possessions in both the Indies, and keeps up factories on both sides of Cape Verde on the African coast. Milan is celebrated for its silk trade; Leghorn is the centre of the English Mediterranean commerce; and Venice, though shorn of its ancient splendor, has an extensive commerce. Antwerp, a city of the Belgic Netherlands, has a very extensive trade. Russia trades with Turkey by the Black Sea, with Persia by the Caspian, with China by land. Madrid has some commercial importance, and Cadiz is a considerable mart. The inland trade of Asia is effected by caravans, which sometimes contain fifty thousand merchants

and travelers. The grand centre of this operation is Mecca, which, in the business season, exhibits an active scene of commercial magnificence. The Persian trade is conducted chiefly by the cities of Bagdad and Bassora. Persia is supplied through the Arabian caravans with European and American commodities.

Merchandise, in obedience to human wants, passes, after various windings, to its destination, as if endowed with intelligence. To England the United States send cotton, for cloths, hardware, and porcelain ; to France, cotton for woolens and silks ; to the West Indies, flour and lumber for tropical produce ; to Mexico, manufactured goods for silver, which is sent to Russia for hemp, to Sweden for iron, to China for silks, teas and furs. The greater part of the skins sold by the Norwegians are obtained from the Hamburgh merchants, who buy them in London from the Hudson Bay Company. The Norwegians carry them to Finmark, from whence they are taken to Moscow, and sold to the caravan traders for the purpose of being bartered with the Chinese for tea at Keachta. Flour, iron, and pork, issue respectively from Baltimore, Philadelphia, and Cincinnati ; and an equivalency returns in shoes, hats, silks, ginghams, calicoes, and tumblers.

Commodities go out in quantities, accumulate in certain locations, and then insinuate themselves into ten thousand families. New York, an inlet for a commercial flood, sends the mighty tide from its centre. Masts surround the city like a grove, smoke hangs over the island, and the murmurs of a busy multitude pervade the streets. Flour from Chicago, cotton from Alabama, furs from Oregon, lead from Missouri, coal from

Pennsylvania, lumber from Maine, pass through this mighty emporium. New Orleans, at one time, exhibits fifteen hundred flats, fifty steam-boats; and ships, brigs, and schooners, present their masts, which, at a distance, resemble large and extensive forests. At London, at the same time are seen three thousand four hundred barges and eleven hundred ships. The docks, occupying no less than one hundred and sixty acres, contain goods amounting to fifty million pounds sterling. They contain one hundred thousand casks, and three thousand bales of silk from Turkey, China, Persia, and Italy. Here appears a mass of ivory; there, half an acre of cinnamon.

Vegetables have been transplanted through commercial intercourse. The almond tree, a native of Barbary, is naturalized from Madrid to Canton; and the orange, the lemon, the lime, and the citron, native fruits of India, are so common in other countries as to give their desserts a tropical character. Indian corn, a native of Mexico, was unknown to Europe before the discovery of America; and the practical mind of Cobbet, whose residence in America informed him of its advantages as food, attempted its introduction into England. After a long opposition, it was discovered to be "marvelous proper food." The queen breakfasts upon it, the premier pronounces it "generous food," and the commons no longer consider it "common or unclean." The potato, a native of the Andes, still grows wild in Chili and Peru, and has spread over the civilized world.

Wheat and rye originated in Tartary and Siberia, where they are still indigenous; and as the oat is found

wild only in Abyssinia, it is considered a native of that country. Coffee, a native of Arabia Felix, is now extensively cultivated in both the Indies. The several varieties of the apple are derived from the crab-apple, a native in most countries; and the peach, formerly used in Persia for poisoning arrows, still grows wild in its native land. The sugar-cane came from China; and the tobacco plant is a native of Mexico, though a species of it has been lately discovered in New Holland. Ginger, so extensively used in cookery and medicine, was first known to the Arabians; and the rhubarb, a native of Tartary, is common in gardens, for making pies. Asparagus was imported from Asia; horseradish, from China; rice, from Ethiopia; beans, from the East Indies; and garlic, from Asia and Africa.

The apple and the pear, some few cherries, and the raspberry and strawberry, are alone indigenous to Europe. The names of most of the flowers, herbs, and fruits, which grow in European gardens, indicate a foreign extraction. The Romans called the apricot, the peach, the pomegranate, the citron, the orange, by the common denomination of apple, which was a native of Italy, and distinguished these new fruits by the additional epithet of the respective country from which each was derived. In the time of Homer, the fruit of the vine which grew wild in Sicily, was ungrateful to the savage inhabitants; but, one thousand years afterwards, Italy had eighty generous wines, more than two-thirds of which were elaborated from her own soil. The vine, which derives its origin from the countries between Persia and India, was brought to Marseilles,

in Gaul. It was communicated by the Romans to the Narbonese province, of Gaul; but so intense was the cold north of the Cevennes, that naturalists, in the time of Strabo, supposed grapes could not ripen in such unfriendly regions. "This difficulty was gradually overcome;" "and the vineyards of Burgundy seem to be as old as the age of the Antonines."

The olive, a native of Syria, "followed the progress of peace, of which it was the symbol." Two centuries after the foundation of Rome, Italy and Africa were strangers to this plant, which was afterwards naturalized and sent into Spain and Gaul. That the olive could only flourish with a certain degree of heat, in a certain proximity to the sea, was an ancient error, which was insensibly exploded by industry and experience. Fruit trees were derived principally from the East; the orange and citron, from Japan; the almond and apricot, from Armenia; the pomegranate, from Africa. One hundred and twenty families of fruit trees are now known to Europe. The sassafras tree, a native of America, was, on account of medicinal uses, sold for a high price on its first introduction into Europe. The Jerusalem artichoke was brought to Europe from the mountains of Brazil. The cultivation of flax, which was transported by the Romans from Egypt to Gaul, enriched the country. The artificial grasses, particularly lucerne, which derived its origin from Media, became familiar to Italy and the provinces. Tobacco, hops, hemp, flax, almonds, pomegranates, grains, and garden fruits, have been introduced into Australia by Europeans.

Seventeen families of fruit trees, mostly exotic, are

cultivated in England, and afford about two thousand varieties. The walnut derived from Syria, is cultivated for its fruit; and the eleven species derived from America, for the finest timbers. Turnips, clover, and potatoes, were introduced into England in the seventeenth century. The cultivation of the turnip, in fifty years, has revolutionized English husbandry. The leaves expose a wide surface to the atmosphere, and derive much of their sustenance from that source. The leaves shade the ground, preserve its moisture, and prevent, in some measure, its exhaustion. Turnips nourish animals which supply food and clothing.

"It was not," says Hume, "till the end of the reign of Henry the Eighth, that any salads, turnips, or other edible roots, were produced in England: the little of these vegetables that was used, was imported from Holland and Flanders. Queen Catharine, when she wanted a salad, was obliged to dispatch a messenger thither on purpose." "Most of the vegetables seem to have been introduced into England from the south of Europe. The artichoke, which is perhaps the oldest, came from the Levant, by way of Italy." "Asparagus and celery came from Italy, through France, and were introduced about the close of the sixteenth century. The cauliflower was brought from Italy, where it was obtained from the island of Cyprus, and was imported into England about the close of the seventeenth century. The beet and the radish came at a later period, from France." The Flemings planted gillyflowers, carnations, and the Provence rose, in England. Hops were introduced from Artois; currants, from Zante; the tamarisk, from Germany; woad, from Toulouse;

the tulip rose, from Vienna; the musk rose and plums, from Italy; garden roots and the pale gooseberry, from Flanders.

Cotton, which was bestowed upon Asia and Africa, was not native to Europe; and, for many centuries, its growth and manufacture were confined exclusively to India. Herodotus states that the Indians made "their clothes" "of a plant" which produced "wool of a finer and better quality than that of sheep;" and Nearchus, Alexander's admiral in his Indian expedition, says that the Indians "wore garments" "of something much whiter than flax, growing upon trees." Cotton, according to Strabo, grew in the Persian province of Susiana; and Pliny states that, in the earliest ages, cotton fabrics were worn only by the Indians; that the dress of the Babylonians "was of linen and wool." Marco Polo, the Venetian traveler, saw cotton growing abundantly at Guzzerat, and in Mosul, opposite the ancient Nineveh, in Persia. Since the time of this traveler, cotton was manufactured in Arabia, Persia, and in all the provinces on the Indus.

In the fifteenth century, cotton was extensively grown and manufactured by the Caffres, by the Moors at Cefala, by the inhabitants of Guinea, and by those who lived along the shores of the Mediterranean Sea. Spain first cultivated it in Europe, and manufactured it into clothing, in the tenth century. The Moors, at the conquest of Spain, brought with them the husbandry of cotton; and the priests of San Adveno let their church lands for its cultivation. Soon after this, cotton appeared in Italy, and gradually extended to

Greece and the adjacent countries. Cotton was grown in the south of France in the sixteenth century.

The aborigines of America, according to Columbus, Magellan, Drake, Dampier, and Van Noort, used cotton for dress. Columbus states that the women of San Salvador were dressed in "cotton coats," that they exchanged "cotton yarn" for toys, and that cotton was seen "growing of itself." The Patagonians tied up their hair with "cotton lace," the Brazilians used cotton for beds, and the Mexicans displayed much ingenuity and neatness in manufacturing cotton fabrics. The earlier explorers of the Mississippi and its tributary streams "saw cotton growing wild" "in great plenty."

A limited quantity of the short staple was grown in America one hundred and twenty years before the Revolution, and the colonists manufactured within their families their most necessary clothing. Jefferson says that their cotton fabrics "bear some comparison with the same kinds of manufacture in Europe." At the convention of Annapolis, Madison remarked to Tench Coxe, that the United States must "one day become a great cotton-producing country." To secure the transportation of the West India cotton, the English procured a stipulation in Jay's treaty that no cotton should be imported from America; which stipulation the United States Senate refused to ratify. An American vessel, which carried eight bags of cotton to Liverpool, was seized on the ground that so much cotton could not be produced in the United States. The States now elaborate more than two million bags, and machinery converts them into clothing.

The most useful domestic animals have been distributed into every region which man has the ability to penetrate. The camel inhabiting the plains of Africa and Asia was carried, in early ages, over India, China, and Middle Russia. It crossed the Bosphorus with the Koran, and spread with the Turks over their present dominions in Europe. The ass, a native of the mountainous regions of Tartary, is celebrated in history for fiery activity and elegant fleetness. He lives in mountains where the horse feeds with difficulty and travels with disadvantage. He has been introduced into South America, for carrying ores from steep mountains; and into the West Indies, for carrying cane from scarcely accessible acclivities. He was introduced into the United States by Washington, whose example has had very considerable influence, and those races now accessible to Americans were obtained from Asia, through Arabia and Egypt.

The sheep of Italy were once celebrated for the fineness of their fleeces. Spain, at a very early period, possessed several varieties of sheep; but the "red fleece" of Boetica, Granada, and Andalusia, a variety which seems to have been originally derived from Italy, was superior to all others in fineness. Columella, a resident of Spain in the reign of Claudius, introduced many of the Tarentine variety into that country. The eggs of the silk-worm were brought in a reed from Asia into Europe, and the making of silk spread into Greece and Italy. The importation of horses into England took place from Spain, Barbary, Arabia, and the Levant. Australia, which possessed

only a few inconsiderable quadrupeds, is now thickly peopled with horses, oxen, sheep and goats.

A maritime situation is one of the physical causes of the superior civilization which distinguishes certain communities. From the shores of the Mediterranean, commerce and art, science and literature, passed through the interior of Europe to the most distant regions. To this sea is traceable the flourishing condition of the ancient cities on the western coast of Asia Minor and Syria, and those on the northern shores of Africa. It contributed to the arts and sciences, the literature and civilization of Greece and Rome, as well as gave rise to the opulence of Tyre and Sidon, Alexandria and Carthage. The Baltic was contributory to the improvement of northern Europe; and both these inland seas contributed to the superiority which Europe acquired over the other grand divisions of the globe.

The extensive and beautiful country of Barbary, separated from Europe by a long and narrow sea, was formerly the centre of an advanced civilization, and noted for population and industry under the Carthaginians, Romans, Vandals, and Arabians. It has a more easy intercourse with the coasts of Europe than those coasts have with their own capital cities. Transportation is less expensive from Marseilles and Genoa to Tunis and Algiers than to Paris and Vienna, or even to Milan or Turin. Cato showed the Roman Senate fresh figs which were gathered under the walls of Carthage; and this fruit, except in a dried state, is not edible after three days from the time of the gathering. Next to Egypt, Barbary was the most fruitful Roman province,

and was called "the soul of the republic," "the jewel of the empire." Opulent citizens considered the possession of palaces and country seats on this beautiful coast as their highest happiness.

The arts and sciences are diffused with commerce; and a high degree of civilization is only attainable by a free and active intellectual intercourse among nations. The progress made by one nation is advantageous to another only by social freedom; and nations usually "improve in proportion to their commercial facilities." The East was in possession of the arts, while the West was inhabited by rude barbarians. The elaborations of more civilized nations were gradually introduced into western Europe, multiplying its commodities, improving its science, and invigorating its commerce. Nations which formerly gazed at each other with suspicion, are now almost merged into one. Misapprehensions, founded on prejudice, are succeeded by friendly offices and beneficial reciprocities. "Vast regions, not many years ago sterile and neglected, have been transformed, as if by some magic influence, into cultivated fields and smiling landscapes."

The Britons who lived in the inland counties were, according to Cæsar, unclothed and savage, while those on the coast, from their mercantile intercourse with Gaul, had made some advances in civilization. The towns in the interior were nothing but huts on an eminence, fortified with trees laid across each other. The walls of the houses were plastered over with mud, and the roofs thatched with straw. Many of their earlier houses were round with conical roofs; and the towns, according to Strabo, were tracts of woody country, sur-

rounded with a ditch. The royal palace differed only in size from the common dwellings. Through Roman art, the woods of Britain gave place to commodious and elegant habitations.

Modern civilization, from its cradle in the south of Europe, passed into Britain. The arts, borrowed from the East, or reanimated after a long slumber, built up the cities in England. Transplanting the arts from Italy to Flanders, laid the foundation of its supremacy in industry and opulence. Among the presents of Haroun to Charlemagne, was a clepsydra, a contrivance beyond anything which had been invented in Europe. With the blessings of peace, a regard for science and the arts grew up among the rude Europeans, who collected the relicts of ancient literature and art into libraries and museums, and viewed them as their noblest acquisitions.

The ancient Germans used vast forests for hunting-grounds, employed some districts in pasturage, and bestowed on the remainder a rude and careless culture. That same country which scarcely supplied a hundred thousand warriors with the simple necessaries of life, now maintains millions of husbandmen and artificers in ease and plenty. Russia, whose first ships were all of foreign construction, now ranks among the great naval powers. Peter the Great persuaded many able artists to accompany him to his dominions, and imported flocks and shepherds from Saxony and Silesia. The vast plains of Russia facilitate land carriage, and her numerous rivers render easy the transportation of commodities with the arts and sciences. Scarcely a hill occurs from Petersburg to Pekin; and many large rivers

meander in various directions through the plains. The people are becoming more agricultural, a regular commerce begins to awaken enterprise, civilization gains ground, and the arts and sciences are spreading their benign influence in some very remote provinces.

The discovery of the new world gave an impetus to mental activity. Green islands and golden sands seemed to arise, as by enchantment, out of the watery waste; and fortunate fields and flowery vales, "thrice happy isles," were fancied to float, "like Hesperian gardens famed of old," beyond Atlantic seas. The heart of man seemed to beat with a new and more vigorous pulsation, and all the energies of the soul to be roused to the most daring adventures. The arts which the emigrants brought to America, enabled them to reclaim its vast solitudes. As the sun first shines on the east and extends his beams to the west, so the fine arts which arose in the East, cast their rays westward till Europe and America became radiant with light. The useful arts of America are reflected upon Russia and Turkey.

Canals serve as a substitute for seas and rivers, contribute to the advancement of inland navigation, and mark the genius of a people in science and commerce. It is impossible to enumerate the advantages derived from this communication between Hull and Liverpool, between the seaports and the manufacturing towns. The elaborations of the counties on the line of the canal, now flow out to satisfy human wants beyond all expectation. The various commodities, both of export and import, find an easy conveyance; and the merchants and manufacturers of the interior enjoy the ben-

efits of water carriage almost from their own doors to the principal seaports. The Severn now communicates not only with the Trent and the Mersey by various courses of navigation, but also with the Thames, by a canal which completes the quadruple intersection of the kingdom.

Literature is improved and disseminated by foreign intercourse. The literature of every nation is marked by its own peculiar genius; but no nation has such a native affluence of expression as to preclude improvement from foreign sources. As private members of society lay aside rude peculiarities and narrow prejudices to catch brilliant thoughts and generous emotions from social contact, so nations, by foreign collision, elevate their habits of thought, acquire more effective modes of expression, and purge their literature from national imperfections. The individual, without sacrificing his originality in deference to society, avoids offensive eccentricities; so the nation which combines its original resources with a suitable flexibility to foreign impressions, attains the highest literary eminence.

The Hebrew literature, the consecrated drapery of divine inspiration, acquired its high elegance by uniting the peculiarity of the Hebrew with exterior impressions. To the fountain of his own native literature, Moses applied a mind rich in "the learning of Egypt;" and the union of these two magnificent streams resulted the Pentateuch, so deservedly admired for elegant diction, lovely simplicity, graphic descriptions, vivid narratives, touching pathos, and comprehensive legislative phraseology. The literature of the com-

monwealth consists of the annals, till the charming history of Ruth marks the transition to a literary period excited by commingling with foreign intellect. The Psalms of David, a repository of sacred poetry, are as varied as the moods of religious sentiment, "as the tones of his own exulting or complaining harp." The traces of Hebrew and Egyptian intercourse are so visible in the literature of this period, that Champollion was impressed with the coincident expressions.

In the time of Solomon, commerce brought the national mind into contact with foreign literature. The Proverbs of Solomon are replete with practical wisdom, expressed in the most appropriate language. The Book of Ecclesiastes, a didactic poem, is adorned with a profusion of beautiful imagery, introduced with a delicate and scrupulous taste. The accumulating infirmities of age are described with physiological exactness, blended with fine poetry and pathos. The Song of Solomon, a series of idyls, combines tenderness of sentiment with fascinating poetic simplicity. The Egyptian princess whom he had married, is called his "sister bride;" and an Egyptian inscription, "sister bride," has been found near the portrait of that very princess, in her native country. She is likened to a "sacred garden;" and sacred gardens, kept by nuns, originated in Egypt.

The diction of Isaiah and Jeremiah indicates a connection with this classic era, and that of Daniel and Ezekiel displays an extreme oriental spirit. The minor prophets fell back upon Jewish resources; but the Rabbinical literature improved from foreign connections, till the Hebrew mind displayed itself in the Grecian language. The chapter on charity "brings

to its illustration a throng of Jewish recollections and sacred inferences." "To the gorgeousness and fervor of Plato, without his vagueness and mysticism, it unites the strict and acute analysis of Aristotle, without his cold, material, mechanical philosophy." The sentiment is logically developed, and "a luxuriant abundance of images is crowded within the smallest possible compass."

The intellect of the ancient Greeks, so spontaneous and original, was not without some foreign stimulus and assistance. Greece was surrounded by nations that preceded her in civilization and literary culture. The Phœnicians pursued an active commerce along the shores of the Peloponnesus ; and the Greeks ascribed to a Phœnician the introduction of sixteen letters of their alphabet. A wondrous resemblance appears between the structure of the Greek and Sanscrit languages—between many portions of the Greek and Indian philosophy. As a refined intercourse existed between the Greeks and orientals, an oriental gorgeousness came into contact with the compact, energetic spirit which characterized the Grecian mind. The perfection of Grecian literature was partly owing to the interchange among the different tribes. They borrowed from each other modes of thought and forms of expression, and elaborated one general literature from the choicest materials.

As a consequence of the commercial activity of the Greeks, their language was spoken throughout all the coasts of the Mediterranean and Euxine seas. The factories which they established and the correspondence which they maintained, diffused their language

throughout the then known parts of the eastern world. The Roman literature, for some centuries, "was like a savage crab-tree, growing in its own native solitude." This language, though brought to its highest state of perfection under the plastic influence of Grecian models, still preserves its native peculiarity. "It is stamped with the mark of an imperial and despotizing republic; rigid in its construction, parsimonious in its synonyms; reluctantly yielding to the flowery yoke of Horace, although opening glimpses of Greek-like splendor in the occasional inspirations of Lucretius; proved, indeed, to the uttermost by Cicero, and by him found wanting; yet majestic in its barrenness, impressive in its conciseness; the true language of history, instinct with the spirit of nations, and not with the passions of individuals; breathing the maxims of the world, and not the tenets of the schools; one and uniform in its air and spirit, whether touched by the stern and haughty Sallust, by the open and discursive Livy, or by the reserved and thoughtful Tacitus."

The mind of Arabia, which had so long slept in solitude and inaction, was lighted up by the influence of the Jewish and Christian Scriptures. Mahomet, the type of his nation, mingled this literature with the old traditionary thoughts and images of Arabia, and awakened its intellect to extraordinary vigor. After a few generations, the Arabians were attracted to Greek and Roman literature, and their genius took a new and sudden flight. They kept the torch of science burning during the dark ages, preserved many literary monuments from destruction, and made some achievements in philosophy, history, mathematics, and poetry. This

classic language, from an uncommon prevalence of vowel sounds, is soft, liquid, and harmonious. As soon as the Arabians adopted the policy of excluding foreign intercourse and attainments, their literature ceased to improve.

In the resurrection of literature, Italy was the first harbinger of day; and a purer style of composition and a more rational strain of sentiment, flowed from the study of the Grecian writers. Cosmo of Medicis corresponded with Cairo and London, and a cargo of Indian spices and Greek books were often imported in the same vessel. The progress of literature repaid the liberality of the Italian princes; and the language of Greece, "the finest ever spoken by mortals," soon spread beyond the Alps. France, Germany, and England, imported the literary flame which had been kindled at Florence and Rome; and the Greek authors, forgotten on the banks of the Ilyssus, were read on those of the Seine, the Elbe, and the Thames.

Before Greece was overwhelmed with her libraries, Italy was emerging from barbarism; and as soon as the seeds were scattered to the winds, the Italian soil was prepared for their cultivation. In the shipwreck of the Byzantine libraries, each fugitive seized a fragment of treasure; and the restoration of Grecian literature in Italy, was preceded by a series of emigrants who were richly endowed with language. At the revival of classic literature, the inhabitants of Europe were noted for rudeness and poverty. European students were introduced to the society of polite antiquity, to familiar converse with those who spoke a sublime and philosophic language. This literary intercourse refined

the taste of the moderns, elevated their genius, and contributed to their superiority in the arts and sciences.

Italy soon brought its language to perfection, and has since enjoyed no splendid literary era. England, which followed in the train of Italy, cultivated the classics, translated the Scriptures, and entered upon her first literary age. The national mind, after languishing for a generation, was awakened to brilliant action by a copious literary influx from France. The literature of the next age was intensely English; and then an intercourse attracted her attention to the literary treasures of the nations of Europe, and she soon exhibited a splendid constellation in the literary firmament. Feeling again too much self-reliance, her literature declined, but the genius of the nation now turned towards Germany, and, with her other resources, produced her unrivalled schools of periodical literature.

The impulse of classic literature was felt by Spain and Portugal. These nations, which produced Cervantes and Camoens, now vegetate in darkness. The few plants which peep through the fissures of their separating wall, manifest a corresponding vigor, and relate the brief story of their literature for two or three centuries. The very alphabet of Russia was the invention of Peter the Great, who, by his visits abroad, was aware of the benefits derivable from foreign civilization and refinement. The few specimens of her literature which have reached English readers, are highly creditable to her genius.

The literature of France, in its earlier stages, savors too much of the classic oil. The revolution dispelled

this restricted system, and France now seeks with avidity for intellectual sustenance from the other nations of Europe. The native vein of the French mind is lively, precise, penetrating, graceful. The French language, from the commingling of these elements, is one of the most refined of modern languages, and is much used in courts and polished society throughout Europe. Germany, in her devotion to classic authors, almost forgot her own nationality; but the popularity of Luther's Translation of the Scriptures, by infusing a solemnity and tenderness, preserved her literature from insufferable pedantry. The unbounded erudition of her sons has brought to light the germ of her original language, refreshed it with French, English, and classic learning, and improved her intellectual harvests. Denmark, Norway, and Sweden, first cultivated Latin, then French, then other European literature, then the old Icelandic and other Scandinavian treasures, "and the result appears to be a promising era of fresh, vigorous, and beautiful emanations."

Population, as well as commerce, has its appropriate mobility. Food is comparatively cheap, manufactures comparatively dear, in locations remote from cities. An artificer in the country, as the expense of transportation intervenes, can sell his commodities at a higher price than the one with whom he competes in the city. The merchandise used by the country artificer is higher, and as soon as agricultural commodities become so much higher in the city as to overcome the other advantages, artificers find it more profitable to locate in the country. Artificers and merchants follow agriculturists, who supply the whole with food; and

various inducements, both of taste and profit, determine population to certain locations. One delights to keep in advance of civilization; another, to linger in the fashionable metropolis.

"The population of the basin of the Mississippi," says Allison, "has increased thirty fold in the last forty years." "This increase" "is mainly owing to the prodigious horde of emigrants from the European States and the older settled maritime" States "of America." "Not less than three hundred thousand persons, almost all in the prime of life, now yearly cross the Alleghany mountains, and settle on the banks of the Ohio or its tributary streams, and behind them another wave of more wealthy and refined settlers appear, who complete the work of agricultural advancement." "The Ohio and the Mississippi and the numerous tributary streams which swell their waters, are covered with steamboats. About two hundred and thirty annually ply upon the Mississippi alone; upwards of five hundred are employed on the rivers, which convey the vast stream of emigration to the western" parts "of the Union."

CHAPTER XII.

THE FIXALITIES.

As every variety of industry is employed upon matter, every pursuit has a particular location. Each elaborator has his distinct plantation, manufactory, or dépôt, a particular location which another cannot occupy at the same time. The locality of industry is a comprehensive induction which applies to every pursuit, and as locations are various in elaborative efficiency, the several elaborators possess very unequal facilities. Equal labor, expended upon different plantations, affords unequal revenues; the proprietor of one mill, with the same expenditure, receives a greater revenue than for one less favorably situated, and a house in Broadway affords a revenue superior to one costing the same for erection in the Bowery. As some agriculturists have superior lands, some manufacturers superior facilities, some merchants superior dépôts, the advantage of location is expressible in a single induction, and denominated fixality.

As location is necessary in every employment, fixality appertains to every pursuit. The lowest profits of agriculture are equal to the lowest profits of the other departments of industry; and all those locations which

afford only the lowest profits, leave nothing for fixality. The best locations, after affording the ordinary profits, leave the largest surplusages; and the space between the highest and the lowest fixalities, is filled up with the various gradations. As long as a resort is continuously made to inferior instrumentalities, fixality continues to rise; as long as industry is continuously flowing from inferior locations, fixality continues to fall. As the line of demarcation between local and ordinary profits is distinctly drawn in nature, philosophic necessity compels us to use a distinctive terminology.

Fixality, which is so clearly marked out by nature, expresses that surplusage which arises from superior locations. The philosophic distinction of this part of revenue is a luminous principle in the Industrial Science. Fixality is a mathematical term, and guides the inquirer with as much certainty as other mathematical terms. The proprietor of a manufactory or warehouse, not only receives an annual revenue for the expense of its erection, but also for the advantages of the ground on which it stands. The fixality often constitutes more than two-thirds of the annual revenue which is received for a plantation, manufactory, or dépôt. Annual revenue includes the whole sum paid for the use of locations with their several appendages, while fixality, with unerring certainty, marks the distinctive part of the revenue which is derived from location alone.

Fixality is inseparable from location, and passive to surrounding circumstances. As its variations are beyond the control of the proprietor, its operations are clearly conservative. As it changes its proprietors without losing its fixed locality, it cannot go in pursuit

of more prosperous adventures. A proprietor can neither augment nor withdraw fixality, but only transfer it to another proprietor, who can only use it where circumstances have given it a locality. The level of commerce is formed upon the tops of fixalities, like the level of water upon the prominency of the equatorial regions. The figure of the earth which is assumed by its rotary motion, determines its fluid level; so the commercial figure which runs through the tops of the several fixalities, determines the commercial level. Fixalities, unlike other commodities, cannot be loosened from locations; and when they begin to decline, proprietors cannot throw them into other adventures, or cause a disturbance in the industrial vibrations.

As proprietors absorb the fixality, elaborators compete with perfect equality. Fixality acts as a safety-valve for the escape of excessive profits, as a fluxion which keeps the system at an even temperature. The motion of the planets results from universal gravitation; so the motion of commodities results from universal competition. Commodities flow over fixalities with the completest harmony. Should the earth cease to turn on its axis, the sea would flow to the sources of the Mississippi; so, should the proprietors remit their fixalities, human pursuits would rush into the wildest disorder. Some elaborators, in the transition state, would receive sudden advantages; those adventurers who should fall upon superior locations, would, with ordinary expenditures, make enormous profits; and every department of industry, as fixalities are so various in intensity, would suffer simultaneous derangement. As the earth is not liable to stop its diurnal

revolutions, so the human mind is so suited to nature that proprietors are not liable to convulse society with injudicious generosity.

Locations gradually acquire superiority by successive accretions. The same expenditure upon different locations was, at the first appropriation, deemed to afford equal revenue; but, from a change of circumstances, these locations have succeeded to very unequal advantages. The comparison of locations, a fluxionary quantity, is made at the same period; and as the capitalist who purchases a location, pays its present equivalency, his income, which is derived from a large fixality, is, to him, after paying for the fixality, only the ordinary profits. As locations are affected by population and improvements, proprietors experience corresponding affections in their respective revenues. The present location of a splendid edifice in Philadelphia, was once assigned to the chain-bearer for laying out the city; and the present immense fixality of the location, has gradually risen up with the successive proprietors through surrounding improvements. Those who purchase locations for future profit, part with a present advantage; and, besides the liability of final loss, they locate capital which might accumulate as fast in other pursuits.

The richness of soils has numerous gradations, and as soon as a country begins to improve, some agriculturists are found nearer to market. Variations, from both these sources, appear in the profits of agricultural locations. Superiority of fertility and proximity of market, render agricultural industry more efficient, and give some landed proprietors a decided advantage.

Remoteness of market is often compensated by superiority of fertility; but when proximity of market coincides with superiority of fertility, the augmentation of profits proceeds in a duplicate proportion. As population increases in a particular district, a corresponding demand arises for agricultural commodities; and as soon as such commodities rise above the medium rate, industry flows into the agricultural channel. As agricultural commodities now afford the ordinary profits to a less advantageous culture, inferior soils and remoter lands are brought into profitable tillage. This necessary resort to inferior instruments, satisfies the pressing demand for food, and checks the comparative advantages of agricultural pursuits. As long as agricultural profits keep in advance, lands less fertile and more remote are brought under profitable tillage; and the resort to inferior instruments only proceeds till the average profits sink a little below the common medium.

The profits of agriculture find the common level; and the boundary of cultivation, like the snow line on the Alps, has its vibrations and equilibrium. As the expulsive force ceases before the most sterile lands come into cultivation, much land in populous districts is always without culture. Gravitation attracts the atmospheric atoms towards the earth, repulsion drives them towards the upper regions; so a demand for food attracts industry to inferior lands, unprofitableness of culture drives it back towards its former boundary. Gravitation and repulsion, at a certain distance from the earth, form an equilibrium with a vacancy beyond; so the pressure for food and the sterility of soils, the

attractive and repulsive forces, form an equilibrium which leaves much land without cultivation. Before cultivation reaches the most sterile soils, the profits of other pursuits arrest its progress; and as land always remains for the play of agricultural industry, agriculture is never permanently more profitable than other pursuits.

A stronger demand for metals so increases the price as to attract industry to inferior mines. The discovery of richer mines sometimes causes inferior ones, such as will not afford ordinary profits, to cease from attracting human industry. The opening of the American mines closed some European mines which had been worked from the time of the Romans; and some of the American mines, which were first discovered, are now superseded by the richer ones since brought to light. The proprietor of the most sterile mines in operation, receives no more than the return of his expenditure with the ordinary profits; while, on the contrary, the richest mines, like the most fertile soils, afford, besides replacing the expenditure of mining, more than the ordinary profits as a fixality. The forests of Norway, the downs of Wiltshire, the mines of Potosi, afford more than the ordinary profits to the landed proprietors. The competition with other pursuits leaves the forces of industry ample room to vibrate.

Some manufacturing locations have intense advantages. Those mills which possess superior power and proximity to market, afford large profits; and this advantage is progressive as long as the demand for manufactures is so urgent as to bring into requisition

less efficient mills, which, under a comparative disadvantage, yield as good profits as other employments. As soon as the profits of manufactures are found to exceed those of other pursuits, the augmentation of price elicits fresh competition ; and as soon as the profits are so far advanced as to admit operations with inferior instrumentalities, manufacturers resort to more expensive propelling powers. The attraction to inferior locations proceeds till prices sink below the common level, when manufacturers abandon inferior instruments. Variety of locations causes variety of intensities in fixalities, and the vibrations keep the system in a salutary equipoise.

Depots which are near to market, have an advantage over those which are more remote. As soon as commercial pursuits become so profitable as to occupy remoter depots, commerce is attracted from the centre towards less favorable locations. The attractive and repulsive powers of mercantile industry, alternately bring into requisition the less profitable depots, and abandon them for more profitable establishments. Mercantile pursuits, which possess inconsiderable friction, soon take that direction which industry seems to require. Some locations have very large fixalities ; and as mercantile locations are alternately appropriated and abandoned, play is left for the vibratory motions and the salutary equilibrium.

The elasticity of competition tends to equalize profits in the several pursuits ; and as the profits are continually seeking repose, the vibrations never lose their final recovery. The pressure of each variety of industry upon inferior instrumentalities, ceases before all

the soils, all the mill seats, all the mercantile locations, are brought into requisition; and population, which creates the demand for every variety of commodities, arrives at its maximum before it presses agriculture, manufactures, and commerce, to the utmost extremity. Materials continually remain for the reception of human industry; and as play remains for vibrations in every variety, the average profits above fixalities can never have a permanent advantage in any pursuit. The population of England, which has doubled in eighty years, still leaves much uncultivated land ready for more pressing emergencies. Fixality so increases with profits that no location has any natural monopoly.

Fixality is a fluxionary quantity, which suits itself to Industrial vicissitudes. The proprietor of every location, except the most unprofitable, has a fixality which fluctuates according to circumstances. Fixation to a particular spot constitutes its only peculiarity; and it continually fluctuates in equivalency while it remains fixed in locality. It fluctuates independently of ordinary profits; sometimes coinciding with, sometimes diverging from, the ordinary vibrations. It fluctuates while ordinary profits continue stationary; it sometimes remains stationary while ordinary profits continue to fluctuate. These vibrations will become more impressive by the introduction of a few illustrative examples.

A manufactory creates a demand for provisions, and augments the advantages in agricultural locations. As agricultural commodities must be elaborated upon inferior and remoter soils, the manufactory, by increasing the disparity of cultivated soils and increasing the

disparity of distance to market, confers a duplicate benefit upon some landed proprietors. A road which makes a distant market accessible, facilitates an established manufactory; and the perishable commodities which now find a nearer consumption, have an effect upon agricultural as well as upon manufactural locations. The price of lands, for all Industrial purposes, augments as a country fills up with inhabitants; and the first settlers often acquire splendid fortunes to transmit to their immediate descendants. The price of the location of Chicago swelled to millions in a few years; and lands in the vicinity of Lancaster sell for three hundred dollars per acre, the facility to market entering into the price.

The population which clusters around manufactories, increases the demand for certain commodities, and gives some manufacturers augmented advantages. The settlement of every country produces the prices of locations in endless variety. Herodotus states that, in his time, India was filled with a numerous population, and crowded with large cities, costly palaces, and magnificent temples. The division of labor had taken place, and merchants had acquired a respectable rank in society. England, for eight hundred years, has been sending out numerous branches from her enormous trunk to form new centres. A spot, once the haunt of the "wild boar of the Ardennes," is now covered with mills and factories, which send up the curling smoke from the once romantic scenery, and gladden the once sylvan solitudes with active industry. Manufactures cluster in cities or villages which enjoy supe-

rior advantages; such as Manchester, Sheffield, Providence, Pittsburg, and Lowell.

Cities favorable for commerce soon acquire splendid advantages from location. Tacitus speaks of London as "famous for its many merchants, for the greatness of its merchandise." Long before the time of Constantine, the commerce of the empire flowed into its market; and Bede calls it "a mart town of many nations, which repaired thither by sea and by land." Its fleet sometimes amounted to five hundred sail, and included every nation in its commerce. Clifford, in the time of Edward the Confessor, says that Bristol was "a famous town, its haven being a commodious receptacle for all ships coming thither from Ireland, Norway, and other foreign countries." Liverpool has rapidly increased from the cotton trade. Less than two hundred years ago, fishes had undisturbed possession of the basin of Baltimore, and ducks congregated in its shallow waters. Many recollect when the spot which is now the most beautiful part of the city, was a play ground for adventurous children, a fine location for shooting snipes. The city is now estimated at more than sixty millions of dollars, and connected by commerce with nearly the whole world. New Orleans, notwithstanding its unhealthy climate, has grown into a large city.

The price of all the locations mentioned in the preceding examples, has been continually augmenting; whereas, at the same time, the price of the commodities elaborated on the same locations, has been sometimes on the ascending, sometimes on the descending scale. The prices of agricultural commodities and the locations advance together, though at very different rates. As

the site of a manufactory is rising in price, the price of the elaborated commodities is falling; and while the lot on which a store stands accumulates to ten thousand dollars, the merchandise sold in the same store is diminishing in price. That the price of locations is liable to diminution and extinction, is exemplified in many melancholy examples.

The flocks of the Arab now procure a scanty subsistence among the vestiges of former agriculture. The banks of the Euphrates and Tigris, once so fertile, are covered with impenetrable brushwood; and the interior of the country, once fertilized by canals, is now destitute of vegetation and inhabitants. In Palestine, where once "every spot on which soil could rest or vine could cling was in cultivation," now large tracts are left waste. The plain of Esdrelon, once exuberantly rich and fertile, has a prolific growth of wild flowers, with here and there only a spot under cultivation. The plain of Sharon, once filled with people, lies almost as useless as the desert of Arabia. Sardinia is cultivated only in spots; and Sicily, once the granary of the Roman empire, pays annually one million pounds for imported grain. A portion of the south of Italy, with a luxuriant soil, is now uncultivated; and around Rome, sometimes not a cottage or a cultivated spot appears for miles.

Drifting sands, in some locations, proceed with frightful rapidity, overwhelming forests, houses, and cultivated fields. They have actually buried, on the coast of Biscay, a considerable number of villages, whose existence is noticed in the records of the middle ages; and, at the present time, they are threatening

no less than ten distinct hamlets with inevitable destruction. The sands of the desert are encroaching upon Egypt, and sand-floods and storms have occurred in Lower Egypt and along the Libyan desert. Denon, a French traveler, had the melancholy opportunity "to walk over villages swallowed up by the desert, to trample under foot the roofs of their houses, to strike against the tops of their minarets." "Cultivated fields," "groves of flourishing trees," and "the dwellings of men," have vanished from human sight and uses. The eastern coasts of England are constantly suffering from the inroads of the sea. The old maps of Yorkshire mark many spots which are now sand-banks in the ocean; portions of Norfolk and Suffolk are annually swallowed up by the waters; and the site of the ancient Cromar now forms a part of the bed of the German ocean.

The Moors found a portion of Spain "fruitful in corn and pleasant fruit, and glutted with herds and flocks;" and, after their expulsion, "the sixteen thousand looms of Seville dwindled down to sixty, and the woolen manufacture almost ceased to have existence throughout Spain." Arabia, which once shed a splendid light on the rest of the world, is now sunk in darkness. Those vast regions over which Islamism ruled or is ruling, are dead to the sciences. Those rich fields of Fez and Morocco, made illustrious through five centuries by so many academies, so many universities, so many libraries, are now nothing more than deserts. The smiling and fruitful coasts of Mauritania, where agriculture, arts, and commerce, were raised to the highest prosperity, became retreats for pirates. Bagdad, formerly

the seat of elegance and knowledge, is in ruins. The famous universities of Cafa and Bassora are closed, and the immense literary wealth of the Arabians exists in monasteries and European libraries.

The great marts of Asia have gone down; and they afford ground for the melancholy admonition of the poet, that

"Trade's proud empire hastes to swift decay."

Tyre, which was "replenished and made very glorious in the midst of the sea," is "broken by the seas in the depths of the waters." Palmyra, once the grand emporium of the Indian trade, lies in ruins, and no longer disperses rich commodities into Europe and Africa. In Clairac's time, the bright vision had vanished from the former capital of Gothland, and the city, with its trade and riches, was destroyed, leaving nothing but heaps of ruins, the sad evidence of its former splendor and magnificence.

The price of locations, in these mournful instances, suffered a final extinction, and, on many of these locations, the price of movables was increasing as the immovables were verging towards extinction.

There is a great cycle in human affairs; and the site on which man locates his industry, is continually altering its exchangeable relations, according to ever-varying vicissitudes. Time, which levels man's proudest works, allows other works to spring up in fresher bloom. Cities now stand where the savage Indian lately held his council of war, where the axe of civilized man lately broke in upon the everlasting silence. "In America all is young, vigorous, and growing—the spring of a people frugal, active, and simple: in Italy all is

old, infirm, and decaying—the autumn of a people who have gathered their glory, and are sinking into sleep, under the disgraceful excesses of the vintage."

Large tracts of coast are forming and encroaching upon the ocean, as along the Baltic and coast of Italy. Rivers, after precipitating soil and alkalies, take a different course and fertilize vast districts. The Mississippi sometimes retrogrades from its general direction; and the fertile valley of the Connecticut has been improved by alluvial deposits. The Po is making changes in the agricultural locations in Italy. On the Mississippi, for two hundred miles, neatly-built houses, on finely cultivated plantations, extend like a continuous village. The savage haunt is now changed into the smiling village or busy city. Orange groves, figs, peaches, and pomegranates, have taken the place of the savage jungle and the almost impenetrable swamp.

Central America "has gone down into oblivion," and "untold ages have passed on in gloomy silence over adamantine relics." "The flourishing countries on the banks of the Euphrates and Indus are now converted into deserts, where the ruins of what were once royal cities are the only records of their former magnificence." Thebes, the city of a hundred gates, extended across the valley of the Nile, its extremities resting upon the bases of the opposite mountains. The area is covered with the ruins of immense temples, sumptuous palaces, magnificent gateways, massive obelisks, and colossal sphinxes. The cormorant sits solitary upon the spot where the conqueror of Egypt once sat upon a magnificent throne. Noph, Zoan, and On, once flourishing cities of Egypt, have scarcely left a trace

of their existence. Balbec, once the seat of luxury and magnificence, is reduced to a collection of miserable huts, inhabited by about a thousand half-savage Arabs. Cæsarea, within the space of twelve years after its foundation, "became the most celebrated and flourishing city of all Syria;" but its theatres, once resounding with the shouts of multitudes, echo no other sounds than the nightly cries of animals roaming for their prey. The Goth trod with mockery over the tombs of the Scipios; and the turbaned Arab erected his tent over the fallen palaces of Numantia.

Chaos covers the once bright spots "where the cheering light of liberty" rose in splendor; where the arts unfolded themselves in every form of beauty and grandeur; where literature loved to linger in academic groves." Athens is a spot of glorious recollections, where "learning slumbers in her marble grave." The proud monuments of sculptors and architects stand, like spirits in snowy robes, upon the Acropolis; and below, pictured walls and ruined monuments stand among a few scattered hovels. The dog howls upon the Pnyx of Demosthenes, the owl hoots from the broken portico of the Parthenon, and the grasshopper chants vespers at the shrine of the Areopagus.

Commerce has declined in Alexandria and Genoa, in Amsterdam and Florence, and ceased in Balbec and Palmyra, in Nineveh and Babylon. Venice, the stately queen of the Adriatic, has experienced many vicissitudes. The people, who fled by night from the besieged Aquilea, settled a cluster of little islands and flats where land disputed with water for empire, and raised a city which became ennobled by taste and enriched by

commerce. The city afterwards declined, and seemed like an emporium anchored in the sea. Within a few years past, she has rallied in commercial prosperity. "More vessels appear in port, throwing up their spars in curving lateen yards against the elegant tower of the custom house. or the picturesque palaces and domes." "A whole fleet of galleys is seen in the hazy distance," not returning, as in former times, from the combats of Cyprus or Candia, but from reclaiming land from the sea.

The price of locations has sometimes long and gentle, sometimes sudden and violent vibrations. A few examples, exhibiting the slowness or rapidity of the price of immovables, will further familiarize the mind with their ever-shifting relations.

Civilization was progressive in India till the Europeans seized upon the country. The natives, formed by nature in a delicate mould of feminine softness, fled from foreign aggressions, and the price of immovable commodities tended rapidly in some places to decay. New England, which now exhibits cultivated farms, comfortable abodes, and clustering spires, was a few centuries ago a howling wilderness. That part of New York beyond Utica, a tract settled within thirty-seven years, contains more than three hundred flourishing towns and villages, adorned with churches of Grecian architecture, and a population of more than six hundred thousand persons. The cultivation of coffee on the plains of San Jose, increased, in seven years, from five hundred to ninety thousand quintals.

Adventurers found refuge and security behind the keys and reefs which protect the harbor of Balize. The

town soon increased to six thousand inhabitants, two-thirds of whom were employed as mahogany cutters. As the trees are nearly all cut down, the town is languishing. In Italy, though in general decay, countless villas, whose graceful columns adorn the embowered banks of Como and the adjacent lakes, have converted a picturesque territory into a modern Arcadia. A sequestered situation in America, several miles from any great route, in a sterile soil, became, from the manufacture of gloves, a happy, opulent, and respectable village. Ummerapoora, in seventeen years after its foundation, contained one hundred and seventy-five thousand inhabitants; and, in ten years more, it decreased to nearly half that number. The increase of population has been so rapid in the United States, that "Cincinnati, Louisville, and other towns on the Ohio and Mississippi, have," in the last forty years, "multiplied above a hundred-fold, and in fact, from obscure hamlets into splendid capitals." Cincinnati, in forty-one years, increased from seven hundred and fifty to more than forty-six thousand inhabitants.

The logic of the muse respecting the "swift decay" of trade, is entirely refuted by the stability of commercial power in many illustrious examples. Trade, like the advance of the moon's motions, has vibrated towards London ever since its first commercial history. Trade was so gently diverted from Seleucia, Persepolis, and Antioch, as insensibly to take another direction; while, on the contrary, it was, through sudden desolations, so suddenly cut off from Tyre, Carthage, and Palmyra, as to occasion commercial convulsions. Alexandria, in her days of prosperity, exhibited a pleasing

scene of industrial activity. "The spacious and magnificent district of Bruchion, with its palaces and musuem, the residence of the kings and philosophers of Egypt, are described above a century afterwards, as already reduced to its present state of dreary solitude."

The advantage of location tends to give population a fixed residence, and to propel the surplus to new adventures. Population spreads with the resort to remoter lands, and enough remains to enjoy the accumulative fixalities. The elasticity of population, by forcing industry to less efficient intruments, propels laborers from the populous centres successively to opposite shores, to navigable streams, to mountainous regions. Population, as well as other fluxions, has its vibrations and equilibrium. As it attains its maximum while lands still remain without culture, play is left for pressing emergencies.

Other causes than a want of food, check population; for many families, affluent for many generations, have a very limited progeny. No Montmorency has ever suffered for food, and yet a family which is traceable back for many centuries, did not, a few years ago, amount to more than eighty-three persons. The population of Tahiti decreased during its transition from barbarism to civilization, and seems to have been stationary for the last thirty years. In the rapid progress to civilization in the Sandwich Islands, the population, as in other groups, decreased before the march of intellectual improvement. In the Hanapepe valley, in Kanai, the population has rapidly decreased. The register of births to deaths has been one to three

for several years past; and this decrease is without any apparent cause. The valley is the most fertile district of the island; the climate is salubrious; the people are temperate; and no known instances of infanticide have occurred for eleven years. The people of Oahu are intellectually improving; and, without any epidemic or prevailing disease, the population is constantly diminishing. The Samaritans are reduced to about one hundred and fifty persons. One of them is in very affluent circumstances, and the others are not remarkable for either wealth or poverty.

CHAPTER XIII.

THE MAXIMUM.

Industrial quantities, like other fluxions, flow into maximums. Limited industry, left in perfect freedom of motion, flows to the greatest possible advantage in supplying wants. A limited surface, formed into a perfect sphere, affords the greatest capacity; and the simplicity of this example renders it peculiarly suitable for illustrating Industrial maximums. Any pressure which destroys sphericity, lessens capacity; so any force upon the channels of industry, lessens human elaborations. Each contributor to the whole mass of commodities, by consulting his own genius, by pursuing a particular employment, by working upon those materials which yield the highest profits, causes his industry to elaborate a maximum to the whole community.

The Deity, leaving no room for human emendations, has, in the several departments, manifested the strictest economy. Straws, reeds, and grasses, are made hollow so as to possess the requisite strength with the least possible material. "The sum of the active forces of any system of bodies, during the time it employs in passing from one position to another, is a maximum."

"If," says Mosely, "I am to project a stone up the hill, or obliquely across it, or suffer it to roll down it, whatever obstacles opposed its motion, whether they arose from friction, resistance, or any other cause, constant or casual, still would the stone, when left to itself, pursue that path in which there was the least possible expenditure of its efforts; and if its path were fixed, then would its efforts be the least possible in that path. This extraordinary principle is called that of least action; its existence and universal prevalence admit of complete mathematical demonstration. Every particle of dust blown about in the air, every particle of that air itself, has its motions subjected to this principle. Every ray of light that passes from one medium into another, deflects from its rectilinear course, that it may choose for itself the path of least possible action; and for a similar reason, in passing through the atmosphere, it bends itself in a particular curve down to the eye. The mighty planets, too, that make their circuits ever within those realms of space which we call our system; the comets, whose path is beyond it; all these are alike made to move so as best to economize the forces developed in their progress." Human labor, in like manner, takes that direction which best economizes the efforts of the human muscles and nerves.

The Industrial maximum, in accordance with other legislation, is radiant with wisdom and benevolence. The Divine legislation, besides assigning to each family the fruits of its united industry, diffuses the greatest possible amount of commodities over universal society The Deity, after making labor a salutary necessity,

turns the whole world into a common mart, that human labor should have the greatest possible efficiency, that the social affections should have the greatest possible enlargement. The very fact of exchange shows a mutual advantage and a mutual dependency; and perfect freedom in all employments and relations, secures maximums in all elaborations. The greater the disparity in location or genius, the greater are the advantages in commerce and social union. Many commodities are unattainable except from particular locations; and, by operating in particular pursuits, civilization is adorned with its refined comforts, elegant arts, and exalted literature.

The Industrial maximum is so clearly revealed, that human restrictions are manifest violations of Divine arrangements, that transgressions are positive infractions, not sins committed in ignorance. In other systems, maximums are difficult to discover, and remain long in the profoundest obscurity. To inscribe the greatest parallelogram in a parabola—the greatest cylinder in a paraboloid,—to determine the angle which gives the fanes of a windmill the greatest efficiency—the divergency of the toes to secure the firmest standing,—are problems involved in the physical sciences. Such maximums are difficult determinations, and their infraction, after the true principle is known, is only a private consideration; but the Industrial maximum, on the contrary, is self-determinate, and its infraction is a positive and gratuitous injury to society. Nature is continually striving after this maximum, and can only be counteracted by actual violence. If a family labors unskilfully, human restriction only causes that

labor to bring a less reward; and, in all cases, restriction leaves the family means the same, and makes the family supplies less abundant.

This maximum is enforced with the tenderest sanctions. A government cannot interfere with commerce without injuring its own citizens, without forbidding them to receive a maximum for their elaborative toils. Restriction by any country is always suicidal; and its whole tendency "is to isolate country from country, state from state, neighborhood from neighborhood, and family from family, with diminished means and increasing poverty as the circle contracts." "The principle of retributive justice is so deeply seated" in the Industrial world, as to recoil upon the country which violates the Divine institutions; for commerce, like hidden streams of water, if turned from its natural channel, often ceases to flow in upon the offending community. The law is enforced with such awful sanctions, that the country which restricts foreign elaborations is the principle sufferer. To restrict foreign food, is, in effect, to shut off blood from human veins; to restrict foreign clothing, is, in effect, to let off warmth from human nerves. The restriction of necessaries can be accomplished only by the cruelest inhumanity and the grossest impiety.

The coal-pits are as beneficial to England as the silver mines are to Peru. The coal which was discovered in the fifteenth century, has been the principal source of opulence to Newcastle; and the lead mines of England support a population which could not subsist on the district by agricultural pursuits. The Phœnicians, six centuries before Christ, introduced

Cornish tin among the Asiatic nations; and fuller's earth, from its manufactural uses, supports many artisans, promotes the opulence of England, and gives activity to commerce. The county of Cornwall, from its soil and climate, has no local attractions. A chain of rugged hills, intermixed with black moors, pervades the whole interior, and exhibits, like most mineral districts, an appearance of dreary desolation. The tin, copper, and lead, which are found in this country, support a population of sixty thousand, exclusive of artificers. These minerals must be elaborated in the locations in which they are cast by nature; and to restrict intercourse between mineral and agricultural districts, is death to the one and serious injury to the other. Freedom of intercourse promotes the advantage of the whole, to the greatest possible extent.

A farmer distributes his respective seeds upon that soil which seems to possess the greatest adaptedness. If one field is suitable for rice, another for corn, a maximum is only attainable by an appropriation of each plant to its appropriate location. The same maximum obtains when these fields belong to different proprietors; for if the one plants all rice, the other all corn, a greater amount is obtained than if each elaborated a plant upon an inappropriate soil. By a mutual exchange, each proprietor obtains the greatest possible amount; and the same maximum obtains when the fields are in different nations, or in different continents. The same principle applies to every agricultural commodity; and any restriction to the introduction or exportation of food, forces plants to uncongenial soils, and is, as far as that restriction extends, dooming the

earth to so much sterility—is subtracting so much from human sustenance.

Some of the French territory is adapted to grain, some to pasturage, some to flax, some to the silk culture. Arid hills produce the vine; mountainous districts, little else than wood. The smallest local peculiarity is turned to Industrial advantage. A rugged mountain affords metals for the farmers on the plain; a district of rocks sends millstones to all the provinces; a small spot of sand yields madder for all the dyers; and a clay field furnishes earth for all the potteries. The inhabitants of the coast send into the interior fish, salt, alkalies, gums, and marine plants. The fertile plain supports a larger population from the facilities received from the other districts, besides the embellishments and amenities arising from social intercourse. The hills abound in plenty, and the rugged mountains teem with human life, imbued with urbanity, affability, and mildness. After supplying the native inhabitants with necessaries, many native plants furnish the world with useful, medicinal, and ornamental commodities.

A perfect freedom in the transmission of lands, as well as of other commodities, satifies wants to the greatest possible extent. Restriction to the sale of lands is a loss both to the holder and to the offerer; for, as the one offers that which the other accepts, the free exchange gratifies both to the greatest possible degree. The landed proprietor, in a free country, must labor to advantage, or his land soon passes to another cultivator. In some sections of Pennsylvania, the lands were so badly tilled that the owners, in the briskness of competition, could not retain possession;

and since these same lands, in the course of events, have passed to other cultivators, they have become fruitful fields. Many landed proprietors, finding competition too strong, sell out to successful farmers, and resort to employments which are more suitable to their peculiar talents. The sluggish fall back upon poor soils; the active make propitious soils teem with fertility. Freedom secures the greatest elaboration; and the briskness of competition diffuses the greatest possible amount of nutritive substances over human society.

The family being directed by a patriarch who must compete with others, elaborates the greatest possible amount. The patriarch is prompted to activity by interest, affection, and duty; and the servant, from the direction of the patriarch, obtains more commodities than his own unassisted labor could procure. The skill of both parties, in their respective spheres, secures the greatest possible amount to the family. The patriarchal institution enables two races, who are separately inefficient, to convert a sandy soil into smiling plenty. Servants, by an unrestricted transferrence, pass to the best managers, and have constant employment and sufficient food—circumstances which render them most efficient in their appropriate avocations.

The division of labor, which gives scope to every variety of genius, affords the greatest possible advantage to the whole society. Elaborators of different capacities have constant and appropriate employment.

The Deity has established among men a diversity of intellectual endowments and tendencies, and every mind is most efficient when it is employed most in

accordance with its natural dispositions and predilections. Each elaborator has full scope for his favorite pursuits, and attains the greatest results with the least actual toil. Mutual advantage extends as far as humanity; and the greater the disparity in elaborative genius, the greater is the advantage in unrestricted intercourse. Human interests are so delicately interwoven with one another, that the necessaries and embellishments of life arise from blending the several talents and employments. Thousands, who are too feeble to obtain sustenance by the labors of the field, perform domestic duties, superintend machinery, or direct operations which are of immense advantage to society. Man is so dovetailed in society that he cannot labor alone without inflicting injury upon his own family.

Man, in society, obtains all available information, and then, like a burning-glass, condenses all the rays upon his favorite pursuit. The prismatic spectrum has a chemical, a calorific, and a colorific focus; so human society, in the genius of its respective members, has a philosophic, an inventive, and a practical focus—an agricultural, a mechanical, and a commercial focus. Every part of industry is excited into its proper focus, and the genius of each member of society, by perfect freedom of pursuit, is brought into a maximum efficiency. The machinist turns his whole attention to the perfection of his specific art, while other laborers are providing his food and raiment in their appropriate employments. Society, by the particular pursuits of its members, obtains its splendid libraries, enchanting museums, and beautiful amusements. Livy spent twenty years in writing his history, which, in consequence, is

characterized for precision, richness, and elegance. Intense sensibility for literary beauty is "ready to obey any invocation" and "to summon intellect and affection into any service promotive of human advancement." Society, from these embellishments, resembles "a beautiful landscape, divided into delightful gardens, green meadows, and fruitful fields."

"In the civilized state, every faculty of man is expanded and exercised; and the great chain of mutual dependence connects and embraces the several members of society." The comprehensive mind ranges over the whole empire of science; and one such mind as Bacon's is enough for the whole human race. Men of commanding ability, though inferior to Bacon, have deduced from his labors inventions and discoveries for ameliorating and embellishing human life. The sentiments, plans, and objects of science, are so harmonized that no disturbance occurs in returning from the scenery of the heavens, to hold converse on humble ground among mortals, to work out the deep problem of active life, heroic passions, and noble achievements. Society is benefited by that enthusiasm which spends years in searching into the fructification of a moss or a mushroom, or examining into the natural history of a gnat or a spider.

Mankind owe their most important advantages to men who have never quitted their closets. To them society is indebted for the mariner's compass, for the security of navigation, for the machines which toil for millions. Science, both chemical and mechanical, has been cultivated by farmers in the retiracy of their studies, and has become the palladium of agriculture

in many places. Gypsum was introduced into America by Franklin, and its effects on vegetation were so signally efficacious as to give it a general introduction. Manning, the great American pomologist, gathered into his collection two thousand varieties of fruits, and his family sent to a public institution two hundred and forty varieties of the pear. Buel, in his last work, embodies, within a small compass, the results of his agricultural experience—a rich legacy to coming generations. The palms of Egypt, which are agitated by the winds, were used by the French in drawing water out of the Nile.

Cully, by agricultural experiments, superior intelligence, and unremitting industry, left a large estate to his family, and contributed to the welfare of the surrounding country. Dawson, by growing alternate crops of grain and roots, advanced the husbandry of the neighboring district, purchased a considerable estate, and left his family in affluence. Bakewell effected improvements in live stock, contributed largely to increase animal food, and opened a branch of farming as novel as it has proved lucrative. He procured sheep remarkable for early maturity, for paucity of necessary food, for the large proportion of the valuable parts. In rearing cattle, the English husbandman has attained a decided superiority, and the subject is exciting much attention in the United States.

The lessons of science enable tne peasant to save fuel, to vary and improve his dish. The art of cookery has been improved, and substances have been applied to appropriate uses by enlightened minds. Chemistry

has applied chrome, iodine, and platinum to the arts, and simplified bleaching, dyeing, and tanning. The conduction of the processes of art invigorates and enlarges the mind, and leads to original and independent inquiries. The accomplished chemist who simplified sugar refining, made a long series of experiments, applied many chemical tests, and made some new discoveries. A German chemist, after diligent research, corrected an alkali in the madder bath; a French chemist, by the distillation of old materials, made a pulp for the sink manufactories; and an English chemist, by correcting copperas with lime, converted a barren soil into a fruitful field. Liebig, by a concentration of his mental energies, has displayed a happy sagacity in tracing out the hitherto hidden operations of vegetable life, in exhibiting a practical demonstration of that comprehensive philosophy which views every accessible relation.

Intentness of application makes discoveries, and applies them with precision to practical results. Men are prompted to invent easier methods of attaining an object to which their attention has been constantly directed. The saving of toil is a strong incentive to invention; and many machines have been contrived or improved by common operatives. The inventor of the eclipse-speeder buried himself in solitude, tasked his mental faculties to the utmost, applied to every available source of information, and directed his intellectual forces to the required point. Watt conveyed water over the Clyde, into Glasgow, through flexible pipes copied from the lobster's tail. Brunel protected the workmen in the tunnel of the Thames by a shield, the

form of which was suggested by the head of an insignificant insect. Smeaton, after anxious inquiry, found the best form for the Eddystone lighthouse in the oak, which was formed for resisting storms and tempests. Boys, to save exertions, sometimes take a directer road to solve a problem; and a boy who was very fond of play, connected the wire with another part of the machinery so as to operate the valve of the steam engine without his care and assistance.

The elder Pliny never travelled without books and an apparatus for making extracts. Biantes, king of Lydia, was excellent at filing needles; Æropus, king of Macedonia, spent his time in making lanterns; and Harcatius, king of Parthia, was the best mole-catcher in the kingdom. Had they solely pursued their appropriate employments, society would have received a great advantage. Nero, to preserve his voice, used to lie on his back with a thin plate on his stomach, took frequent emetics and cathartics, and, at last, transacted all business in writing. Suetonius informs us that the emperor played on the flute, and came in a triumphal procession through Italy, bearing the spoils which he had won in one thousand eight hundred musical contests. Had he been confined to music as a profession, the empire would have escaped many distressing calamities.

The weavers of Lyons, in their holyday leisure, are seen gathering flowers, grouping them into engaging combinations, and suggesting new designs which give rise to elegant patterns. A school of arts takes charge of every youth who shows an aptitude for drawing, or imitative design, applicable to manufactures. The

school has a botanic garden, and devotes five years to the instruction of youth in anatomy, botany, architecture, and loom-pattern drawing. The school has collections of silk fabrics for study, and explains the mode of executing the several patterns, some of which reach far into antiquity. The manufacturer selects that boy who seems to have the best taste and invention; and the weaver descants on the merits of several hundred patterns, and seldom errs in predicting the success of any new style. The most eminent painters, sculptors, botanists, and florists, devote to these patterns "their happiest conceptions." Flower patterns, being copied from nature, are remarkably free from incongruities. The French supply taste to the civilized world, exporting one hundred and ten millions out of one hundred and forty millions to foreign countries. "Their fancy articles in iron and steel are exported in large quantities," "and their bronze figures have made their way into all parts of the world, alongside of their silk goods."

Several occupations which are not a little disgustful by nature, become agreeable by habit. Nature sometimes seems to forget its tenderness, and science has its martyrs. Science ameliorates the evils entailed upon humanity by sin, and "there must be a compensation to justice for this abridgment of its penalty." Humboldt looked down into the crater of a volcano; and many of the votaries of science, like Pliny, venture too near to Vesuvius. Dixon's process of transfer was the result of patient and long continued research. Being a printer and a chemist, he sought for some substance which would exert an influence upon the ink so as to

enable him to obtain a copy. After a long series of failures, impaired health, and pecuniary exhaustion, his efforts were crowned with the completest success. Mankind enjoy the advantages of steam navigation, as a reward for the long struggles of the laborious and persevering Fulton.

As man improves by education, the greatest possible benefit accrues to society when each member attends to a particular pursuit. Appropriate exercise improves sensorial acuteness, manual dexterity, scientific invention, philosophic discovery, and literary accomplishments.

The senses of those persons whose business leads to nice exertions, become very acute. Touch becomes exquisite in men whose employments require them to examine polished bodies. The practice of attending to different flavors, wonderfully improves the powers of distinguishing them and of tracing their composition. Nothing is more improvable than an ear for music. Only the simplest compositions are first relished, then the finer melodies, then the intricate and compounded pleasures of harmony. They who deal in microscopic observations, or engrave upon precious stones, acquire surprising accuracy of sight in distinguishing the minutest objects. An eye for the beauties of painting, is gradually formed by being conversant with the finest pictures.

The sculptor who is gifted by nature, needs instruction in the management of his chisel and in the anatomy of the human body. Painting was first performed in a uniform tint, then with various hues without shading, then according to life with light and shade.

The painting of fictile vases seems to have been practiced by artists who received a peculiar instruction. Each workman in a manufactory, as he makes a similar operation his sole employment, acquires a skill and rapidity otherwise unattainable. This division, in some instances, increases the efficiency several hundred-fold. Human skill can perform a quantity and quality of work, which, to a casual observer, would seem to be utterly impossible.

No practical man can be sure of success without science, which teaches him to conduct his operations by less expensive, circuitous, and ineffectual methods. Ingenuity is ever multiplying expedients to subdue refractory substances, and to transfer into useful agents the wildest and most stormy elements. To the philanthropic mind, the highest end of grand inventions is to supersede labor, which, through its beneficial partition, is in some departments almost reduced to the mental effort of superintending the mechanic powers which are pressed into human service. The more true science one possesses, the higher will he reach in the scale of perfection, and the better will he be qualified for the suggestion and accomplishment of noble and useful undertakings. Belgium and Tuscany, now so distinguished for agriculture, were once no less celebrated for commerce. As Europe advanced in arts and civilization, commerce was almost exclusively confined to these two countries. When commerce fell into decay, agriculture proved a fortunate resource for industry. The people transferred their capital and enterprise, and the union of energetic and methodical arrangement made them excellent agriculturists.

The mind which is properly trained, always keeps a principle in view, and clears away the difficulties which always beset unexplored paths. A science is the compilation of the laws of the universe upon a single point; and the progress of education is marked by the number of laws which it reveals, and the multiplicity of the relations which it unfolds. A mind trained to investigate these laws, achieves conquests, and removes countless infelicities. Those trains of thought which follow the order of premises and conclusions, are the most effective instruments in discovery. From Archimedes to Galileo, scarcely any discovery or invention appears. The same night which shrouded the genius of discovery, brooded over the talent of invention. Galileo applied discovery to art; and the impulse of discovery and invention seem to be inseparable. So great is the power of education, that Chavius, who was noted for stupidity, became an expert mathematician.

Sparta trained her citizens to one pursuit, allowing no preference for favorite occupations. Freedom in Athens produced models of poetry, of oratory, of the arts, which scarcely fall short of ideal excellence. Nothing is more conducive to happiness than the free exercise of the mind in congenial pursuits. Pericles remarked that the Athenians, without submitting to the hardships of a Spartan education, rivaled the achievements of Spartan valor, and had their literature and polite amusements as so much clear gain. Society, by freedom, acquires the command of knowledge, refinement, and religious instruction—the true elements of happiness and prosperity. The habit of reading brings its own satisfaction; and libraries are

stores of instruction and amusement. The period of the revival of letters in Christendom, is, in many respects, one of the most brilliant eras in human history. Mankind, in almost every quarter of Europe, woke up from profound sleep to adventurous activity.

Men, in a free society, have a powerful stimulus and a heavy pressure to awaken the faculties, and to call forth exertions. "Ability and necessity," says Pythagoras, "dwell near each other," and usually inhabit the same building. Activity of mind is excited to its highest point by competition with those engaged in the same pursuit. "By competition," says Clay, "the total amount of supply is increased," and it furnishes a maximum to society when it reigns unobstructed throughout the whole world. The laborer, in the keenness of competition, must "gather up the fragments." He must improve his elaborative facilities, or be superseded by those who labor under more favorable auspices. He has the prospect of transferring his services to loftier pursuits, and he mounts up, laboring, during the whole series of ascent, to the maximum efficiency. New wants exhibit themselves in an elegant age; and new occasions arise for the exercise of the strictest economy. The inventive powers, never growing weary, are aroused to the greatest possible activity.

An unrestricted competition also diminishes consumption. Any indulgence granted by government to any particular pursuit, is not only prejudicial by the injury inflicted on others by taxation, but tends also to slacken mental energy, and to excite to extravagance

in spending funds drawn from other employments. The laborer, in the freedom of competition, can only spend his own funds; but, in monopolies, the favored individuals spend the funds exacted from others. Theophylact, the Patriarch, had in his stable at the same time above two thousand hunting horses, fed upon the richest dates, grapes, and figs steeped in wine.

A maximum elaboration arises when government protects every family in the fruits of its own industry. The gradual enlargement and cultivation of the sense of property, "from its feeble force in the savage state to its full vigor and maturity among polished nations," constitute "a very instructive portion of the history of civil society." By obedience to the laws of property, man brings all his faculties into exercise, and is enabled to display his various and exalted powers. He makes investments, "casts his bread upon the waters," and awaits the return with patience and confidence. This leads out the mind to profitable and comprehensive adventures, and the whole country is benefited by a maximum improvement.

Man, in the use of previous discoveries, elaborates to the greatest advantage. The application of motive powers, though in some cases suggested by artisans, has been perfected by philosophers. In man's earlier efforts at architecture, the materials were perishable, the forms ungraceful, and the structures unstable. He improves in the art, erects buildings endless in variety, beautiful in finish, and suited to withstand the violence of time and the elements. The last fifty years are

illustrious in the arts; many new patents have been obtained, and beautiful models are suggesting new improvements. The votary of science, though he may never overtake the light of Newton or Franklin, can follow its path, and guide his footsteps by its illumination.

The Saracens, in the middle ages, cultivated astronomy with several facilities. "The costly instruments of observation were supplied by the Caliph, and the land of the Chaldeans still afforded the same spacious level, the same unclouded horizon." Agricultural associations tend to promote social intercourse, to make farmers emulous of excelling in their crops and buildings, in the neatness and order of their domestic arrangements. Landseer, Woolette, Lowry, Byrne, and Heath, have carried the art of engraving to great perfection. Much of the labor consists in forming patterns; and ornamental stove-plates, costing a year's exertion in executing the pattern, are cast in less than an hour. The engraver spends years in preparing a plate from which an impression, costing a few cents, is taken in less than a minute.

As the hint which one proposes is carried to perfection by another, the greatest possible achievements arise from association. Arkwright, who was conversant with machinery, was obliged to call in the assistance of others in completing his spinning apparatus. Wedgewood, who originated the manufacture of fine pottery in England, constantly employed a distinguished chemist; and the light of science which guided his successors, has diffused elegant wares into

the humblest cottages. Each of the great dye-works in Alsace, so celebrated for beautiful and permanent colors, is superintended by a distinguished chemist. The French manufacturers generally keep a well-educated chemist constantly experimenting upon colors, in a well-furnished laboratory.

Davy was patronized by Beddoes and the Royal Society. The Duke of Bridgewater denied himself ordinary accommodations, sent an agent through the country to borrow money, and supported Brindley in executing his stupendous plans of internal improvements. Chemistry and mechanics, with the aid of Bolton, enabled Watt to invent an engine, which has almost changed the face of civilized countries. Watt was studious and reserved ; Bolton was affable and suited for bringing the invention into public notice. Watt never assisted in the construction of the first models, and only visited the factory once in a week. Nearly fifty thousand pounds were expended before his engines brought any returns. The remuneration was one third of the saving of fuel above that of the atmospheric engines, and the proprietors of three engines proposed, at last, to compound for two thousand four hundred pounds per annum.

One does not elaborate that which he can buy with the fruits of less labor. The tailor does not make his own shoes, nor does the shoemaker make his own clothes. Each, by exchange, obtains a better article with less labor. Each laborer employs himself in some particular occupation, and receives from others the elaborations which he needs. The baker is furnished

with music, which he could not elaborate at all, and the musician has better bread than he could make with his own hands. A certain artist confined himself to mezzotinto engraving; and one collection alone contains one thousand eight hundred of his engravings.

Perfect justice, as well as freedom, causes human labor to flow out to a maximum efficiency. When the patentee receives his proper reward, the introduction of a new machine is so gradual as to allow less efficient machines to go gently out of use. When a philosopher receives a remuneration for his discovery, no sudden change ensues in old employments, or in the price of commodities. Time is allowed for the change of employments, so that great improvements operate softly, and every thing settles to its proper level without jolts or revulsions. As a manufacturer must pay a high price for a new effective machine, he cannot sell his elaborations so cheap as to jostle others suddenly out of the same pursuits.

The preceding pages contain the amplifications which have arisen out of a single principle. Human labor, the only contemplated principle, constitutes a regular articulated system, each part of which displays the nicest connection and completest harmony. Wheels within wheels move with ceaseless activity, and the whole appears like one great animated personage. Each elaborator only considers his own part, and the other parts are fitted to his actions. He is placed in the centre of a great web, each thread of which is con-

nected with a thousand others. The involuted fabric is bound together by crossings and twistings, and exhibits elegant complexity in unbroken unity. This nicely-contrived system, by displaying the Divine wisdom and benevolence, leads the devout mind to admire, obey, and adore.

THE END